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Mass. Secretary of the Commonwealth
May 28 1928.

REPORT OF THE METROPOLITAN DISTRICT WATER SUPPLY COMMISSION

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To the Honorable the Senate and House of Representatives of the Commonwealth of Massachusetts in General Court Assembled.

The Metropolitan District Water Supply Commission, established under the provisions of Chapter 375 of the Acts of the year 1926, respectfully presents for the year ending November 30, 1927, its

SECOND ANNUAL REPORT

I. Organization and Administration

There has been no change in the personnel of the Commission during the year. Davis B. Keniston has continued as Chairman, and Charles M. Davenport and Joseph H. Soliday as associate commissioners. Charles M. Davenport continued to act as secretary until March, 1927, when R. Nelson Molt became secretary.

The clerical force of the Commission's office at Boston has been organized during the year and on November 30, 1927, consisted, in addition to the secretary, of one senior clerk, one bookkeeper, one clerk and one stenographer. Two title examiners have been employed in the field. A real estate purchasing agent and conveyancers have been employed from time to time as required.

The engineering and clerical force of the engineering department has been built up from 48 employees on November 30, 1926, to a total of 133 employees on November 30, 1927. The maximum force during the year was 138 during the week ending August 13, 1927, and the average force was 100.

II. Engineering Department

Frank E. Winsor has continued as chief engineer. Karl R. Kennison has continued as designing engineer and Walton H. Sears as mechanical engineer.

Three division engineers are in charge of field divisions as follows: Harold W. Horne, Wachusett-Coldbrook Tunnel Division; Richard R. Bradbury, Coldbrook-Swift Tunnel Division; and N. LeRoy Hammond, Swift River Reservoir Division. Harold W. Horne continued as assistant division engineer from last year and N. LeRoy Hammond reported permanently for duty as assistant division engineer on December 1, 1926. They were promoted to division engineers on June 1, 1927. Richard R. Bradbury reported for duty as division engineer on August 1, 1927.

X. H. Goodnough, Chief Engineer of the State Department of Public Health, and J. Waldo Smith, formerly Chief Engineer of the New York Board of Water Supply, have continued as consulting engineers. Charles T. Main of Boston has been employed from time to time as consulting engineer on mill and water power damages, and Professor Charles P. Berkey of Columbia University as consulting geologist.

III. Offices

Since the beginning of the year the offices of the Commission and of the Chief Engineer have been in the Five Cents Savings Bank Building at 24 School Street, Boston.

Four field offices have been maintained for the whole or parts of the year. That of the Wachusett-Coldbrook Tunnel Division was continued at Holden Center and that of the Swift River Reservoir Division was continued at Enfield. Headquarters for the Coldbrook-Swift Tunnel Division were established at Hardwick on September 15, 1927, and for the Southern Sudbury Emergency Supply at Framingham on December 20, 1926.

IV. Real Estate

During the year 667 requests have been received from the owners of real estate, located in and near the Swift River Valley, for appraisal by the Commission of the value of their holdings, making a total of 740 such requests to date.

The total included in these parcels of land whose owners have thus indicated their willingness to sell is approximately 32,200 acres, all but about 2,500 acres

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of which may be required to be purchased. Property offered for sale that is located within the limits of the proposed reservoir or sufficiently near its margin to make it desirable for protection has generally been referred to the appraisers of the Commission for a report as to its value. To date nearly 11,000 acres have been purchased and about 4,700 more are under option. Tables showing the distribution of this acreage among the various towns in the Swift Valley and showing the progress of real estate acquisitions throughout the year are appended hereto.

A width of at least 50 feet was taken for the Wachusett-Coldbrook Tunnel, 25 feet each side of the center line. In general the land required for the tunnel was taken in fee. On parts of the tunnel line between shafts an easement for the tunnel construction, operation and maintenance was taken and, in the same location where practicable, an easement for the construction, operation and maintenance of an electric transmission line was also taken. In some places, however, easements were taken for the transmission line and for access to the shafts other than along the center line of the tunnel. The land required for camp sites and spoil banks at the various shafts was taken in fee.

The pipe lines for the Southern Sudbury Emergency Supply required in general the taking of an easement across private property of varying widths. The land required for the pumping station on the pipe line from Hopkinton Reservoir to Sudbury Reservoir and for outlet works at the end of this line was taken in fee. Also the land required for the Whitehall open channel, small diversion dam and reservoir in the town of Hopkinton was taken in fee.

The line from Hopkinton Reservoir to Sudbury Reservoir was laid a distance of approximately 3,200 feet in the public highways where no taking of private land but only an easement in the highway was required. Similarly the Ashland pipe line followed the public highways for a distance of approximately 4,150 feet.

V. Danger of Water Shortage

The shortage in the water supply for the Metropolitan District was so imminent and apparent to the Legislature in 1926 when the Ware River legislation, Chapter 375, Acts of 1926, was enacted, that in the act the Commission to be appointed was expressly directed to proceed forthwith with the work contemplated in that enactment. By the winter of 1927, the danger of a water shortage, with the Wachusett Reservoir, the main source of supply, half empty, was more apparent than in the previous year. The Legislature of 1927 therefore enacted Chapter 111, Acts of 1927, for an emergency supply from the head waters of the Sudbury River in the Southern Sudbury region for immediately augmenting existing supplies. In this legislation, it was also provided that the work should proceed forthwith. In 1927 the Legislature further enacted the definitive legislation for the Swift River development, Chapter 321, Acts of 1927, and again expressly directed the Commission to proceed forthwith with the work. Every effort has been made by the Commission to carry out these emergency injunctions of the Legislature.

The Southern Sudbury emergency water supply provided for in Chapter 111, Acts of 1927, was made available, in part, for use about six months from the passage of the legislation and the progress to date insures its being wholly available by the end of the calendar year. All possible speed has been exercised by the Commission to make the flood waters from the Ware River supply provided for in Chapter 375, Acts of 1926, available not later than the winter and spring of 1931, the shortest time structurally feasible. Unusual rainfalls in the late fall have temporarily relieved the current shortage impending for 1928, but have not altered the general situation requiring that the additional supply be made available at the earliest possible date, and not later than the spring of 1931.

VI. Progress of the Work

Studies have been made to determine the probable effect of the proposed takings by the Metropolitan District upon the flow of the Connecticut River. The matter is more fully discussed in the report of the Chief Engineer appended hereto.

Early in the year 1927 the Commission, through its Chief Engineer, presented data and contemplated plans for the Ware River and Swift River projects to the District Engineer of the Corps of Engineers, United States Army. Applications have been made and are now pending before the War Department for formal permits for the diversion from the Ware River, as authorized under Chapter 375 of the Acts of 1926, and for the diversion from the Swift River, as authorized by Chapter 321, Acts of 1927.

Ware River Supply

Surveys were continued to locate suitable shaft sites on the line of the Wachusett-Coldbrook Tunnel, and Contract 1, for borings along the line of the tunnel, was continued to determine the location of proper ledge rock structure for the tunnel and shafts.

On April 27, 1927, Contract 10 was made with the New England Power Co. for constructing, maintaining and operating a 22,000 volt transmission line connecting all shafts of the Wachusett-Coldbrook Tunnel. The purpose of this transmission line is to furnish power for the construction of the shafts and tunnel. Its construction was completed June 20, and it is to be maintained and operated, during the period of construction of the tunnel or any extension of it.

Six construction shafts have been sunk along the line of the Wachusett-Coldbrook Tunnel. Contract 4, for sinking Shaft 5, and Contract 8, for sinking Shafts 6 and 7 in the Town of Rutland, were awarded to James J. Coughlan & Sons, Inc., Boston, Mass., on March 28, 1927, and May 24, 1927, respectively. Contract 12, for sinking Shafts 2, 3 and 4 in the Towns of Holden and Rutland, was awarded to the Dravo Contracting Co., Pittsburgh, Pa., on May 24, 1927. The lining has been completed in all shafts under construction, 2 to 7, inclusive, and excavation is being made in the tunnel at the shaft bottoms. At Shaft 2 tunnel excavation, beyond the limits set by the original contract, has been continued by the contractor at a modified price.

Bids for the construction of the Wachusett-Coldbrook Tunnel, including Shafts 1 and 8, the outlet and intake respectively, were opened November 18, 1927, but the contract has not yet been awarded.

Swift River Supply

As required under the provisions of Chapter 375, Acts of 1926, this Commission submitted to the General Court on the first Wednesday in January, 1927, a draft of legislation for the development of an adequate future water supply from the Swift River. The Swift River legislation, Chapter 321, approved April 26, 1927, provides for the immediate extension of the Wachusett-Coldbrook Tunnel to the Swift River, the construction of a storage reservoir in the Swift Valley and the diversion of the total flow in excess of 20 million gallons daily guaranteed at Bondsville about five miles downstream from the main dam. Chapter 321 authorizes an expenditure of $50,000,000 in addition to $15,000,000, authorized by Chapter 375, Acts of 1926, and in addition to $900,000 authorized by Chapter 111, Acts of 1927.

Surveys of real estate have been continued during the year. Topographic surveys have been made of the dam and dike sites and portions of the reservoir area, and studies made for highway relocations.

Contract 2, for borings at the dam and dike sites, was continued to determine the location and character of bed rock and overlying material.

Aerial surveys have been made by the Fairchild Aerial Surveys, Inc., of the entire Swift River Valley, Contract 3, and along the Chicopee and Ware Rivers, Contract 9.

A census has been made of burials in all cemeteries which may be affected by the reservoir. The work of copying inscriptions and locating each headstone or monument has been partially completed.

Southern Sudbury Emergency Supply

The report of the Commission recommending that an additional emergency supply be made available from the Southern Sudbury sources, published as House Bill 221 of 1927, was filed December 1, 1926. The legislation as approved on March 15, 1927, in Chapter 111, provided for the diversion, if required for emergency use, of the inferior waters of Whitehall and Hopkinton Reservoirs, and of the Sudbury River at Cordaville into the main Sudbury Reservoir, and of Ashland Reservoir into the Sudbury Aqueduct, authorizing therefor an expenditure of $900,000.

On September 2, 1927, a taking was made of all the waters of Indian Brook at a point at or immediately below the dam of the Hopkinton Reservoir of the metropolitan water district, in the Town of Ashland, for diversion into the Sudbury Reservoir or Sudbury Aqueduct of the district, or both.

Seven contracts for this work were awarded during the year. These included four contracts for pipe lines totalling approximately 37,000 feet in length; one contract for a small pumping station; one contract for an open channel approximately 5,000 feet in length; and one contract for the furnishing of electric power for operation of the pumping station.

Provision has been made for chlorinating the entire supply and for the construction, if later deemed desirable, of a decolorizing plant at the outlet of the Hopkinton line into the Sudbury Reservoir.

At the request of the selectmen of the Town of Southborough and at their expense three fire hydrants were installed on the pipe line from Hopkinton Reservoir to Sudbury Reservoir in the vicinity of the Village of Cordaville. These hydrants will be available for connection to pumping engines at such time as the pipe line is in use, but no obligation has been assumed to keep water in this line.

Actual diversion from the Hopkinton Reservoir into the Sudbury Reservoir was begun on November 15 at the rate of 5 million gallons per day and was continued at this rate throughout the month.

VII. FINANCIAL STATEMENT

The Commission presents the following abstract of its expenditures and disbursements from July 28, 1926, to and including November 30, 1927:

GENERAL OVERHEAD

	Year Ending Nov. 30, 1927	Total to Nov. 30, 1927
ADMINISTRATION:		
Salaries, Commissioners	$10,499.94	$14,112.80
Salaries, Clerical, Commissioners' Office	7,039.03	7,519.03
Furniture and Equipment, Commissioners' Office	2,237.15	2,237.15
General Legal Expense, Commissioners' Office	414.48	414.48
Automobile Maintenance, Commissioners' Office	249.77	249.77
Miscellaneous Expense, Commissioners' Office	4,023.22	4,131.58
Total Administration	$24,463.59	$28,664.81
ENGINEERING, HEADQUARTERS OFFICE:		
Salaries, Engineering	$62,961.11	$67,804.81
Salaries, Clerical	8,329.90	8,597.90
General Consultant Expense	7,480.59	9,080.44
Furniture and Equipment	7,565.08	8,408.09
Rent and Upkeep	11,840.15	11,840.15
Automobile Maintenance	247.77	257.30
Miscellaneous Expense	4,726.40	5,010.21
Total Engineering, Headquarters Office	$103,151.00	$110,998.90
UNASSIGNED:		
Unassigned Supplies and Equipment	—$39.00	$1,573.98
Total Unassigned	—$39.00	$1,573.98
Total General Overhead	$127,575.59	$141,237.69

DISTRIBUTION OF GENERAL OVERHEAD

	Year ending Nov. 30, 1927	Total to Nov. 30, 1927
ADMINISTRATION:		
Wachusett-Coldbrook Tunnel Division	$9,799.39	$10,975.73
Coldbrook-Swift Tunnel Division	1,349.37	1,349.37
Swift River Reservoir Division	7,378.94	9,017.42
Southern Sudbury Emergency Supply	5,935.89	7,322.29
Total Administration	$24,463.59	$28,664.81
ENGINEERING, HEADQUARTERS OFFICE:		
Wachusett-Coldbrook Tunnel Division	$41,039.57	$43,380.30
Coldbrook-Swift Tunnel Division	4,643.29	4,643.29
Swift River Reservoir Division	31,705.73	34,817.99
Southern Sudbury Emergency Supply	25,762.41	28,157.32
Total Engineering, Headquarters Office	$103,151.00	$110,998.90

WACHUSETT-COLDBROOK TUNNEL DIVISION

	Year ending Nov. 30, 1927	Total to Nov. 30, 1927
GENERAL OVERHEAD:		
Administration	$9,799.39	$10,975.73
Engineering	41,039.57	43,380.30
Total General Overhead	$50,838.96	$54,356.03
ENGINEERING:		
Salaries, Engineering and Clerical	$45,728.15	$47,072.94
Furniture and Equipment	7,212.74	9,684.64
Automobile Maintenance	2,228.12	2,254.48
Miscellaneous Expense	18,964.28	19,056.66
Consulting Expense	545.65	545.65
Rent and Upkeep	1,934.56	1,934.56
Total Engineering	$76,613.50	$80,548.93
REAL ESTATE:		
Legal and Expert Expense	$2,044.05	$2,044.05
Miscellaneous Expense	225.00	225.00
Purchases and Settlements	16,560.00	16,560.00
Taxes	104.34	104.34
Total Real Estate	$18,933.39	$18,933.39
WARE WATERSHED PROTECTION:		
Legal and Expert Expense	$448.33	$448.33
Consultant Expense	566.40	566.40
Labor	470.00	470.00
Miscellaneous Expense	22.21	22.21
Purchases and Settlements	223,283.18	223,283.18
Taxes	4,960.92	4,960.92
Total Ware Watershed Protection	$229,751.04	$229,751.04
WARE SUPPLY DAMAGES:		
Consultant Expense	$591.70	$591.70
Total Ware Supply Damages	$591.70	$591.70
WARE DIVERSION DAMAGES:		
Consultant Expense	$452.39	$452.39
Miscellaneous Expense	1,265.00	1,265.00
Total Ware Diversion Damages	$1,717.39	$1,717.39
CONTRACTS:		
Contract No. 4 — Sinking Shaft 5	$92,423.16	$92,423.16
Contract No. 8 — Sinking Shafts 6 and 7	121,166.73	121,166.73
Contract No. 10 — Constructing Transmission Line	88,606.59	88,606.59
Contract No. 12 — Sinking Shafts 2, 3 and 4	181,163.16	181,163.16
Total Contracts	$483,359.64	$483,359.64
PERMANENT CONSTRUCTION EXCEPT CONTRACTS:		
Miscellaneous Expense	$441.44	$441.44
Total	$441.44	$441.44
Total Wachusett-Coldbrook Tunnel Division	$862,247.06	$869,699.56

COLDBROOK-SWIFT TUNNEL DIVISION

	Year ending Nov. 30, 1927	Total to Nov. 30, 1927
GENERAL OVERHEAD:		
Administration	$1,349.37	$1,349.37
Engineering	4,643.29	4,643.29
Total General Overhead	$5,992.66	$5,992.66
ENGINEERING:		
Salaries, Engineering and Clerical	$7,661.50	$7,661.50
Furniture and Equipment	3,796.37	3,796.37
Automobile Maintenance	611.15	611.15
Miscellaneous Expense	8,731.08	8,731.08
Rent and Upkeep	89.40	89.40
Total Engineering	$20,889.50	$20,889.50
REAL ESTATE:		
Legal and Expert Expense	$192.84	$192.84
Miscellaneous Expense	7.50	7.50
Total Real Estate	$200.34	$200.34

	Year ending Nov. 30, 1927	Total to Nov. 30, 1927
PERMANENT CONSTRUCTION EXCEPT CONTRACTS:		
Miscellaneous Expense	$91.87	$91.87
Total	$91.87	$91.87
Total Coldbrook-Swift Tunnel Division	$27,174.37	$27,174.37

SWIFT RIVER RESERVOIR DIVISION

	Year ending Nov. 30, 1927	Total to Nov. 30, 1927
GENERAL OVERHEAD:		
Administration	$7,378.94	$9,017.42
Engineering	31,705.73	34,817.99
Total General Overhead	$39,084.67	$43,835.41
ENGINEERING:		
Salaries, Engineering and Clerical	$53,662.58	$54,010.05
Furniture and Equipment	6,015.33	8,083.68
Automobile Maintenance	1,991.96	2,005.14
Miscellaneous Expense	38,882.86	38,925.14
Rent and Upkeep	230.64	230.64
Total Engineering	$100,783.37	$103,254.65
REAL ESTATE:		
Legal and Expert Expense	$27,867.25	$27,998.30
Miscellaneous	541.15	541.15
Purchases and Settlements	960,802.08	960,802.08
Taxes	4,367.31	4,367.31
Total Real Estate	$993,577.79	$993,708.84
SWIFT RESERVOIR DAMAGES:		
Consultant Expense	$921.47	$921.47
Total Swift Reservoir Damages	$921.47	$921.47
SWIFT DIVERSION DAMAGES:		
Consultant Expense	$1,360.54	$1,360.54
Miscellaneous Expense	1,369.21	1,369.21
Total Swift Diversion Damages	$2,729.75	$2,729.75
PERMANENT CONSTRUCTION EXCEPT CONTRACTS:		
Miscellaneous Expense	$214.78	$214.78
Total	$214.78	$214.78
Total Swift River Reservoir Division	$1,137,311.83	$1,144,664.90

SOUTHERN SUDBURY EMERGENCY SUPPLY

	Year ending Nov. 30, 1927	Total to Nov. 30, 1927
GENERAL OVERHEAD:		
Administration	$5,935.89	$7,322.29
Engineering	25,762.41	28,157.32
Total General Overhead	$31,698.30	$35,479.61
ENGINEERING:		
Salaries	$26,179.25	$26,333.14
Furniture and Equipment	3,667.86	4,940.61
Automobile Maintenance	965.03	978.21
Miscellaneous Expense	1,832.84	1,863.04
Consultant Expense	2,525.63	3,816.25
Labor	173.00	173.00
Rent and Upkeep	425.18	425.18
Total Engineering	$35,768.79	$38,529.43
REAL ESTATE:		
Legal and Expert Expense	$1,176.60	$1,176.60
Consultant Expense	30.00	30.00
Purchases and Settlements	7,038.22	7,038.22
Total Real Estate	$8,244.82	$8,244.82
SOUTHERN SUDBURY DIVERSION DAMAGES:		
Consultant Expense	$869.50	$869.50
Settlements	24,000.00	24,000.00
Total Southern Sudbury Diversion Damages	$24,869.50	$24,869.50

	Year ending Nov. 30, 1927	Total to Nov. 30, 1927
Contracts:		
Contract No. 5 — Cordaville Pipe Line	$74,181.73	$74,181.73
Contract No. 6 — Cordaville Pumping Station	13,985.23	13,985.23
Contract No. 7 — Hopkinton Pipe Line	112,836.10	112,836.10
Contract No. 11 — Ashland Pipe Line	110,042.86	110,042.86
Contract No. 13 — Whitehall Pipe Line	43,130.46	43,130.46
Contract No. 16 — Whitehall Open Channel	6,239.07	6,239.07
Total Contracts	$360,415.45	$360,415.45
Permanent Construction except Contracts:		
Miscellaneous Expense	$8,517.16	$8,517.16
Total	$8,517.16	$8,517.16
Total Southern Sudbury Emergency Supply	$469,514.02	$476,055.97

SUMMARY

	Year ending Nov. 30, 1927	Total to Nov. 30, 1927
Wachusett-Coldbrook Tunnel Division	$862,247.06	$869,699.56
Coldbrook-Swift Tunnel Division	27,174.37	27,174.37
Swift River Reservoir Division	1,137,311.83	1,144,664.90
Southern Sudbury Emergency Supply	469,514.02	476,055.97
Unassigned	—39.00	1,573.98
Grand Total	$2,496,208.28	$2,519,168.78

VIII. OTHER REPORTS

The report of the Chief Engineer explaining in detail the work of the engineering department is herewith presented. It includes a summary of information of geologic interest, in accordance with the requirements of Section 2 of Chapter 321, Acts of 1927.

Respectfully submitted,

DAVIS B. KENISTON,
CHARLES M. DAVENPORT,
JOSEPH H. SOLIDAY,
Metropolitan District Water Supply Commission.

24 SCHOOL STREET, BOSTON, MASSACHUSETTS.
January 14, 1928.

REPORT OF THE CHIEF ENGINEER

To the Metropolitan District Water Supply Commission.

GENTLEMEN: — The following is a report of the engineering department for the year ending November 30, 1927.

ORGANIZATION

The engineering organization has increased in numbers as the work of the department has expanded and construction begun.

Karl R. Kennison, Designing Engineer, has in charge all studies in connection with the general plan of the work and the design of structures, the preparation of contracts, specifications, contract and working drawings. He takes care, generally, of the executive work of the department.

Walton H. Sears, Mechanical Engineer, has in charge the collection of data for use in the settlement of mill and water power damages. He assists in the design of work of a mechanical nature and in the preparation of contracts and specifications.

Three Division Engineers are in charge of field divisions as follows: Harold W. Horne, Wachusett-Coldbrook Tunnel Division; Richard R. Bradbury, Coldbrook-Swift Tunnel Division; N. LeRoy Hammond, Swift River Reservoir Division.

Walter Knowles, Assistant Engineer, has in charge the field work for the Southern Sudbury Emergency Supply.

X. H. Goodnough, Chief Engineer of the State Department of Public Health, and J. Waldo Smith, formerly Chief Engineer of the New York Board of Water Supply, have continued as Consulting Engineers. Charles T. Main, consulting engineer of Boston, has reported on mill and water power damages. Professor

Charles P. Berkey, geologist of Columbia University, has advised as to sub-surface investigations, particularly in regard to the location of the tunnel from the Wachusett Reservoir to the future Swift River Reservoir, and in regard to dam and dike foundations.

The number of employees under the direction of the Chief Engineer at the end of the year and of the preceding year was as follows:

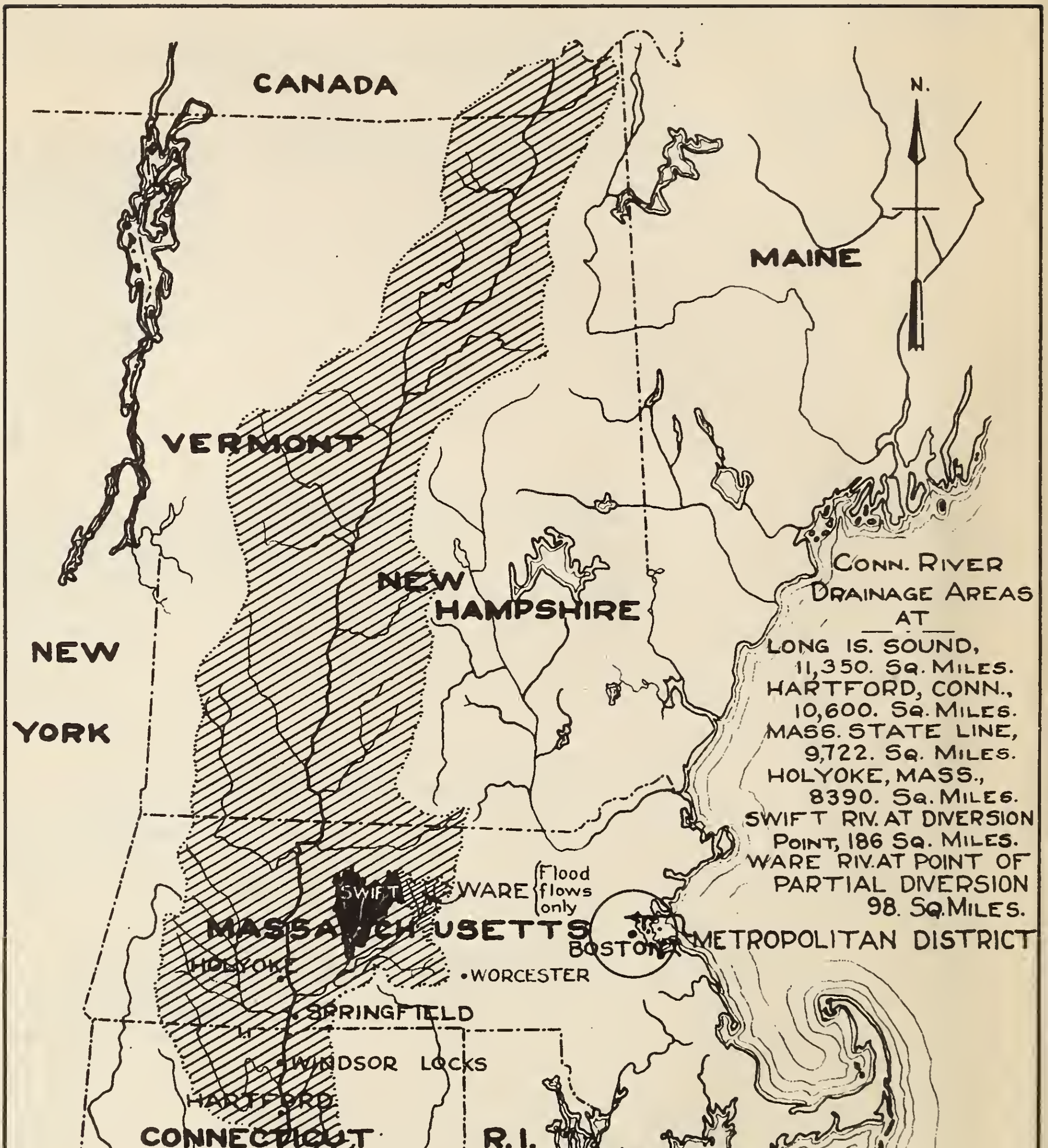
PERSONNEL OF ENGINEERING DEPARTMENT

Classification	Nov. 30, 1926	Nov. 30, 1927
HEADQUARTERS OFFICE, CHIEF ENGINEER AND DESIGNING DIVISION:		
Chief Engineer	1	1
Designing Engineer	1	1
Mechanical Engineer	1	1
Assistant Engineers	6	9
Draftsmen	2	6
Instrumentman	–	1
Rodmen	4	2
Senior Stenographer	–	1
Stenographers	4	3
Bookkeeper	1	–
Clerks	2	2
File Clerk	–	1
Office Boy	1	1
	23	29
HOLDEN OFFICE, WACHUSETT-COLDBROOK TUNNEL DIVISION:		
Division Engineer	–	1
Assistant Division Engineer	1	–
Assistant Engineers	3	5
Draftsmen	–	2
Instrumentmen	–	4
Rodmen	6	10
Axemen	1	3
Inspectors	1	7
Stenographer	–	1
	12	33
HARDWICK OFFICE, COLDBROOK-SWIFT TUNNEL DIVISION:		
Division Engineer	–	1
Assistant Engineers	–	2
Instrumentmen	–	3
Rodmen	–	8
Axemen	–	2
	–	16
ENFIELD OFFICE, SWIFT RIVER RESERVOIR DIVISION:		
Division Engineer	–	1
Assistant Division Engineer	1	–
Assistant Engineers	2	7
Draftsman	–	1
Instrumentmen	1	5
Rodmen	9	16
Axemen	–	6
Inspector	–	1
Clerk	–	1
	13	38
FRAMINGHAM OFFICE, SOUTHERN SUDBURY EMERGENCY SUPPLY:		
Assistant Engineers	–	4
Instrumentmen	–	3
Rodmen	–	4
Axemen	–	2
Inspectors	–	4
	–	17
Total Engineering Force	48	133

The maximum force during the year was 138, during the week ending August 13, 1927. The minimum force was 50, during the week ending December 4, 1926. The average force for the year was 100.

OFFICES

The office of the Chief Engineer and Designing Division was continued in the Five Cents Savings Bank Building at 24 School Street, Boston. The field office



CONN. RIVER
DRAINAGE AREAS
AT
LONG IS. SOUND, 11,350. SQ. MILES.
HARTFORD, CONN., 10,600. SQ. MILES.
MASS. STATE LINE, 9,722. SQ. MILES.
HOLYOKE, MASS., 8390. SQ. MILES.
SWIFT RIV. AT DIVERSION POINT, 186 SQ. MILES.
WARE RIV. AT POINT OF PARTIAL DIVERSION 98. SQ. MILES.

COMMONWEALTH OF MASSACHUSETTS
METR. DISTR. WATER SUPPLY COMMISSION
WATERSHED OF CONNECTICUT RIVER
AND PORTIONS OF WATERSHEDS OF THE SWIFT AND WARE RIVERS FROM WHICH IT IS PROPOSED TO DIVERT WATER FOR THE WATER SUPPLY OF METROPOLITAN DISTRICT
OCTOBER 1927.

of the Wachusett-Coldbrook Tunnel Division was continued at Washburn Hall, Holden Center. On September 15, 1927, the field office of the Coldbrook-Swift Tunnel Division was established in the brick school building on the Common at Hardwick. The field office of the Swift River Reservoir Division was continued in the Felton Block at Enfield. The field office for the Southern Sudbury Emergency Supply was established on December 20, 1926, at 5 Hollis Street, Framingham.

HEADQUARTERS OFFICE

Summary of the Year's Work

Legislation for Swift River Development. — In accordance with Chapter 375, Acts of 1926, a draft of legislation for the development of an adequate future water supply from the Swift River was required to be submitted by the Commission to the General Court on or before the first Wednesday in January, 1927.

Many engineering studies were made in connection with the preparation of this draft and its subsequent modification by legislative committees. On January 26, 1927, the various mill owners along the Chicopee and Swift Rivers, affected by the proposed diversion of the waters of the Swift River, were invited by the Chief Engineer to a conference for the purpose of expressing their views in the matter. Correspondence supplemented by various conferences was carried on with the District Engineer of the War Department prior to the passage of the Swift River legislation.

Effect of Ware and Swift River Diversions on Connecticut River Flows. — Studies have been made to determine the effect of the authorized diversions for the Metropolitan District of waters from the Swift and Ware Rivers upon the flow of the Connecticut River. The drainage areas of the Connecticut River at various points and of the Ware and Swift Rivers have been determined as follows:

CONNECTICUT RIVER DRAINAGE AREAS

	Square Miles
Connecticut River at Long Island Sound (entire area)	11,350
Connecticut River at Hartford, Conn.	10,600
Connecticut River at Windsor Locks, Conn.	9,760
Connecticut River at Massachusetts State Line	9,722
Connecticut River at Holyoke, Mass.	8,390
Ware River at Coldbrook (flood waters only taken and dry weather flow of Connecticut River not affected)	98
Swift River, including a small area at the head of Beaver Brook which now flows into the Ware River	186

These areas are also shown on the accompanying plan.

From the 186 square miles of the Swift River drainage area, enough water will, in accordance with the requirements of Chapter 321, Acts of 1927, be released at all times to insure a flow of 20 million gallons per day at Bondsville on the Swift River, about five miles below the proposed dam. The portion of the Swift River drainage area authorized to be diverted forms 1.64 per cent of the total drainage area of the Connecticut River, and 1.75 per cent of the drainage area at Hartford, but due to the above mentioned guaranteed flow of 20 million gallons daily, there will be no diminution of the natural flow at times of extreme drought, and the amount of water to be diverted in times of ordinary low flow during the driest months in the average year would be the equivalent of the total diversion of water from an area less than one per cent of the total drainage area of the Connecticut River.

Real Estate. — Reports with recommendations have been made to the Commission as to the necessity or desirability for purchasing the various parcels of land offered for sale by owners located in and near the Swift River Valley. A total of 32,200 acres has been included in these reports to date. Similar reports have been made relative to properties involved in other projects under charge of the Commission located outside the Swift River Valley.

Taking plans have been prepared covering all the land necessary for the construction of the Wachusett-Coldbrook Tunnel and for the pipe lines, pumping station and open channel of the Southern Sudbury Emergency Supply. Fifteen taking plans covering 140 parcels of land were required for the tunnel, of which fourteen have been filed, and fourteen taking plans covering fifty-nine parcels of land were required for the Southern Sudbury Emergency Supply, all of which have been filed.

Preliminary studies have been made of highway and cemetery relocations to determine the amount of land required.

Contracts and Specifications. — Twelve contracts have been awarded during the year. These include one minor contract for aerial surveys and one for furnishing electric power; the remaining ten contracts are for construction and total approximately $1,100,000.

Six of these contracts, totalling $450,000, are for construction for the Southern Sudbury Emergency Supply, including four for pipe lines totalling approximately 37,000 feet in length, one for an open channel approximately 5,000 feet in length and one for a small pumping station.

The other four contracts, totalling $650,000, are for construction for the Ware River Supply. Three of these are for construction shafts for the Wachusett-Coldbrook Tunnel totalling approximately 2,600 feet in depth, and one for an electric transmission line along the tunnel line for furnishing power needed for construction of the shafts and tunnel.

The required contract drawings and specifications have been prepared for these twelve contracts and working drawings have been issued from time to time as the work has progressed. Plans and specifications were also prepared for the proposed tunnel contracts for construction of the Wachusett-Coldbrook Tunnel from the Wachusett Reservoir to the Ware River at Coldbrook. The forms for these contracts were completed and the work advertised for bids which were opened on November 18, 1927.

Inspection and Tests. — Arrangements were made with Messrs. Skinner, Sherman & Esselen, Inc., Chemists and Engineers of Boston, for the testing of cement used on various contracts. Samples were at first taken from each car upon receipt at the work and shipped to their laboratory. Later arrangements were made for the sampling of each car at the cement mill at the time of shipment, these samples also being shipped immediately to their laboratory. Under these arrangements approximately 6,500 barrels of cement have been tested for the tunnel shaft linings under Contracts 4, 8 and 12. Approximately 500 barrels for these contracts were inspected and tested at the mill by E. L. Conwell & Company of Philadelphia.

Messrs. Conard & Buzby of Burlington, New Jersey, were employed to make mill inspection and tests of concrete pipe furnished by the Lock Joint Pipe Company under Contract 5, and cast iron pipe and valves furnished under Contracts 5, 6, 7, 11 and 13 for the Southern Sudbury Emergency Supply. Under these arrangements about 8,700 linear feet of 30″ concrete pipe have been inspected and tested, and 3,400 tons of cast iron pipe, sizes 12″, 18″, 20″ and 24″.

Tests of sand, brick and several small quantities of cement for various parts of the work have also been made by Skinner, Sherman & Esselen, Inc.

Aerial Surveys. — Work was continued, under the direction of the Headquarters Office, on Contract 3, with the Fairchild Aerial Surveys, Inc., for furnishing photographs obtained from aerial surveys of the entire Swift River Valley. The snow covered the ground before the west branch of the river had been photographed, necessitating the postponement of this work until spring.

The direct contact prints on a scale of approximately 1 inch equals 1,200 feet were found extremely useful to the field office in locating real estate boundaries and other physical features. It had been expected that enlargements to a scale of 1 inch equals 400 feet would prove even more valuable, but on account of the great differences in elevation of ground surface encountered it was not found practicable to obtain these enlargements to a sufficiently accurate scale. The usefulness of the smaller contact prints, however, more than justified this method of obtaining rapid surveys.

Contract 9, for aerial surveys along the Chicopee and Ware Rivers, was made with the Fairchild Aerial Surveys, Inc., on March 30, 1927, and the photography was promptly completed. Contact prints covering the entire distance from Chicopee to Coldbrook have been received together with enlarged prints of selected areas.

Index maps have been made of the contact prints obtained from these surveys.

They cover the entire length of the east, west and middle branches of the Swift River above Three Rivers, the Chicopee River from Chicopee to Three Rivers, and the Ware River from Three Rivers to Coldbrook.

Hydrographic Data. — A careful study of available data bearing on the flow of the Swift, Ware and Chicopee Rivers and on the rainfall upon their drainage areas has been made. Existing stream gaging stations and rain gages have been visited to determine what additional stream gaging stations may be desirable. The streams and watersheds have been reconnoitered to determine the most practical locations for such additional hydrographic stations. Stream gaging and other hydrographic work will, it is expected, be done in co-operation with the U. S. Geological Survey. One gaging station is already in process of construction on the Ware River at Coldbrook just below the proposed point of diversion into the tunnel at Shaft 8.

Considerable hydraulic field work has been done at the Boston Duck Mills of the Otis Company at Bondsville on the Swift River. The water power plant has been rated and other flow determinations have been made so that the stream will be continually gaged and the flow of the river in the past may be computed from existing records of plant operation.

For several days following the unusual flood that extended over the New England area early in November, 1927, various flood and flow measurements were made, in co-operation with the Hardwick office, on the Ware, Swift and Chicopee Rivers. Flood heights on all three rivers were recorded, and stream gagings were made on the Swift River at Bondsville and on the Ware River at White Valley just below Coldbrook.

Design of Structures

Tunnel Profile. — Gradient studies of the proposed Wachusett-Swift Tunnel have been made to fix the average slope of the tunnel and elevations of the invert at certain critical points. The general slope is downward from west to east, the grade line capacity being figured from a minimum draw-down to Elevation 435 in the Swift River Reservoir to the flow line of the Wachusett Reservoir at Elevation 395.

To facilitate drainage during construction each heading extending easterly from its construction shaft, instead of sloping downward, will be continued level until it meets the up grade extended westerly from the adjoining shaft. The tunnel will be level for the entire distance between Shafts 7 and 8 to assist the removal at Shaft 7 of air which will be unavoidably taken into the tunnel with the Ware River floods at Shaft 8 at Coldbrook.

At the east end of the tunnel at Shafts 1 and 2, sub-surface investigations showed that in order to insure an adequate depth of sound rock above the tunnel arch, the grade of the tunnel would have to be lowered about 200 feet more than requirements of the hydraulic gradient would indicate. The tunnel can then be operated under pressure with suitable control gates at the Wachusett end so that whenever desired the entire flood flow of the Ware River can be diverted westerly for storage in the Swift River Reservoir.

Tunnel Sections. — The tunnel will be lined with unreinforced concrete and will have a cross-section area equivalent to that of a circle 12′ 9″ in diameter. This will provide a combined carrying capacity of approximately 2,800 cubic feet per second for the flood flows of the Ware River at Coldbrook to the Wachusett Reservoir and to the proposed Swift River Reservoir. Until the tunnel is extended beyond Coldbrook, the carrying capacity to the Wachusett Reservoir only will be about half this quantity.

Two typical tunnel sections have been designed; one of the horseshoe type which will be used in sound rock and which will undoubtedly form the greater part, if not the entire length, of the completed tunnel; and one circular to be used where the rock is of poor quality and has a tendency to slip and bring excessive pressure against the tunnel lining. Each type includes a design where no support of the rock roof is required during construction, one where temporary support only is required and one where permanent support is required.

Although the ground water will probably be above the hydraulic gradient at all points practically all of the time, the concrete lining has not been designed to resist the external hydrostatic pressure, but this pressure will be vented through weepers in the lining.

Construction Shafts. — In order to accomplish the diversion of the Ware River flood flows in 1931 and relieve any shortage of the water supply of the District which may occur before that date the construction of the Wachusett-Coldbrook Tunnel has been designed to be carried on by headings from eight shafts as follows: Shaft 1, 205 feet deep, the outlet into Wachusett Reservoir at the Quinapoxet River basin near Oakdale; Shaft 8, 253 feet deep, the intake on the Ware River near Coldbrook; and for construction purposes six construction shafts varying from about 8,800 feet to 11,600 feet apart and from 313 to 656 feet deep. The construction shafts will have permanent unreinforced concrete linings 14′ 0″ in diameter.

It was desired to locate the top of Shaft 2 slightly above the future level of the Swift River Reservoir and as near to the Quinapoxet River as possible in order that water from that river might at some future time be diverted through the tunnel to increase the amount of water power available for development at Shaft 1, when and if the power plant installation will have been made there. Investigations by borings indicated, however, that it would be necessary to locate the shaft at a higher level and at some distance from the river in order to strike sound rock near the surface without having to sink the shaft to any great depth in water-bearing earth. The designs have made provision, by suitable openings in the lining of Shaft 2, for the construction of future diversion works at such time as the value of the increased water power will justify the expense.

Shaft 1. Outlet to Wachusett Reservoir. — Four principal considerations in the design of Shaft 1 were the outlet from the tunnel into the Wachusett Reservoir, the measurement of flow through the tunnel, provision for a future water power development and also for unwatering the tunnel.

As designed, the outlet will consist of two horizontal openings at the shaft head discharging into a short open channel which will take the water into one of the upper branches of the Wachusett Reservoir at the Quinapoxet River basin. The retaining walls for the outlet channel are to serve as a foundation for a future hydroelectric power station. The installation of the generating equipment will be delayed because no water power will be available until there is adequate storage in the Swift River Reservoir, but the power house may be built in the near future to provide housing for cranes, pumps and miscellaneous equipment required in the tunnel operation. One of the horizontal openings will be used for the future penstock connection and the other for a blow-off.

The designs provide for the measurement of the entire discharge from the tunnel into the reservoir, by two Venturi meters, one for high flows and the other for low flows. The larger one will be vertical and cast in the concrete lining of the shaft. This meter with a ninety-inch throat will measure flows up to the maximum capacity of the tunnel for diverting flood flows easterly from the Ware River directly into Wachusett Reservoir, namely about 1,500 cubic feet per second. The smaller meter, of thirty-six inch throat diameter, will be installed in the outlet channel in a horizontal position. This meter will measure flows ranging from the minimum capacity which the large meter is capable of measuring accurately down to the lowest anticipated rates of diversion from the Ware River and the East and Middle Branches of the Swift River until the Swift River Reservoir is ready for storage. This thirty-six inch meter will be of a temporary nature and will be dismantled when the Swift River Reservoir is completed and the power equipment installed at Shaft 1.

On account of the necessity for lowering the grade of the tunnel at its east end to ensure support in sound rock, the volume of water in the tunnel below Elevation 390, *i.e.*, low water in the outlet channel, will be approximately 21,000,000 gallons, and provision must be made for handling this amount, plus any leakage into the entire tunnel, by emergency pumping equipment when it is desired to unwater this portion of the tunnel for inspection or repairs.

Several methods were considered but the final decision was to build in addition to the main outlet at Shaft 1 an additional pump shaft or well of equal depth but of smaller diameter. This second shaft will be pumped out by a small pump, then a centrifugal pump and motor will be lowered to the bottom and connected up for pumping out the tunnel.

The entire Shaft 1 will be excavated and lined initially as a single shaft and used in that form during the work of excavating and lining the tunnel. Upon the completion of this work the partition separating the main outlet shaft and the smaller pump shaft will be installed, the pump shaft having a steel interlining to insure watertightness.

Shaft 8. Ware River Diversion Works. — The Ware River intake to the tunnel will consist of Shaft 8 and the diversion control works at the surface. Four principal considerations in the design were the diversion of the flood flows above the prescribed limit of 85 million gallons daily, the measurement of the quantity diverted and that left in the stream, the exclusion of air so far as possible from the water taken into the tunnel and the dissipation of the energy due to the drop in the shaft, the tunnel invert being approximately 260 feet below the level of the river.

Various methods of diverting and measuring the flow have been studied and good progress has been made in the details of the design. The general plan is to divert the water through several siphon spillways of various capacities which will insure the complete diversion above the prescribed limit and prevent any diversion below this limit. These spillways will discharge into a large well directly over the shaft. From this well the fall into the shaft will be controlled by four large butterfly valves automatically maintaining a water seal for the exclusion of air and insuring the submergence of a Venturi meter set vertically over one of the valves. This meter will measure the amount diverted under all ordinary conditions up to its capacity of approximately 700 million gallons daily. For extreme floods in excess of this amount the quantity may be estimated from measurements at other points.

The water will be discharged into the shaft at a point about 200 feet above the tunnel. Several different methods of dissipating the energy were studied. Theoretical investigations led to the conclusion that water discharged tangentially against the side of the shaft at an angle with the vertical would, by virtue of its centrifugal force, keep to the outside of the shaft and maintain a smooth fall in a helical path with minimum impact. Also, that if helical guides were constructed on the inside of the shaft lining they would maintain the circular motion of the water and preserve its centrifugal force, and cause the water to reach the bottom of the shaft in the form of a thin sheet pressing firmly against the shaft lining, the thin sheet dissipating its energy in an adequate depth of water at the bottom of the shaft. It has been decided to line Shaft 8 with cast iron as a further precaution against deterioration of the concrete under the high velocity and possible impact of the fall of water into the shaft.

Because of the importance attached to this principle in the design of the shaft lining, tests, under the direction of Professor Charles M. Allen, have been made on a 1/20 scale model at the Alden Hydraulic Laboratory of the Worcester Polytechnic Institute. The tests were made to cover the entire range of operating conditions and to show the effect of various forms of guides cast in the lining of the shaft.

The shaft will be excavated and lined initially with concrete and used in that form during the excavation and lining of the tunnel. When completed the shaft will be lined with cast iron and the results of the laboratory tests on the model are being used in determining the form of the castings which will make up the finished lining.

Sanitary Precautions in Wachusett Watershed. — Special sanitary precautions will be taken during the construction operations at Shafts 1 to 4 inclusive, which are located within the drainage area tributary to the Wachusett Reservoir, and particularly at Shafts 1 and 2, which are close to this present source of water supply. The specifications which have been prepared covering the construction of the tunnel from these shafts require extreme care in the control of the contractor's employees, the inspection of camps and the treatment of all wastes and drainage. The designs for sanitary works at these shafts include drains, settling basins and suitable provision for chlorination of all surface drainage. Further-more, at Shafts 1 and 2 designs have been prepared for slow sand filters to take care of the drainage and insure against any contamination of the existing water supply.

Diversion Works for Southern Sudbury Emergency Supply. — Chapter 111, Acts of 1927, authorized the development of the Southern Sudbury Emergency Supply by diverting into the main Sudbury Reservoir, or directly into the Sudbury Aqueduct, the waters from selected areas at the headwaters of the Southern Sudbury watershed, which would have a sufficiently low color and satisfactory quality for mixing with the present supply without filtration.

Designs were made which involved three separate pipe lines, a pumping station, an open channel and appurtenant structures as follows:

1. A gravity flow 24-inch pipe line from the Ashland Reservoir of the District to the gate house at Framingham Reservoir No. 2 which is connected by an existing 48″ cast iron main to the gate house at Framingham Reservoir No. 1 at the head of the Sudbury Aqueduct.

2. A gravity flow 20-inch pipe line from the Whitehall Reservoir of the District to a point where City Brook, a small tributary of the brook flowing from Whitehall Reservoir, crosses City Road or Proctor Street, in the town of Hopkinton. Also a small diversion dam and reservoir at this point and an open channel to divert the entire natural flow tributary to the diversion reservoir as well as the discharge from the pipe line over the divide into the Hopkinton Reservoir of the District.

3. A gravity flow 30-inch pipe line from the Hopkinton Reservoir of the District across the Sudbury River near Cordaville and over the divide into the upper reaches of the main Sudbury Reservoir of the District. Also a pumping station at Cordaville, containing a two hundred fifty horse power motor-driven centrifugal pump, and a branch line to an intake at the mill pond of the Cordaville Woolen Company, so that the pipe line to the Sudbury Reservoir can take either the gravity flow from the Hopkinton Reservoir or the pump discharge from the Sudbury River at Cordaville. The pump can also be used as a booster in the gravity line from the Hopkinton Reservoir.

On account of the urgent need of this emergency supply for the District, the field reconnaissance and surveys were rushed to early completion, taking plans prepared for the necessary land and rights of way, and the entire construction carried to practical completion within the year. The specifications were prepared calling for bids on either cast iron Class A (American Water Works Association) or reinforced concrete pipe in the case of the thirty-inch line from Hopkinton Reservoir and the twenty-four inch line from Ashland Reservoir. For the smaller twenty-inch line from Whitehall Reservoir cast iron pipe Class A was specified.

The flow through the Hopkinton line into the Sudbury Reservoir will be measured by a 30″ x 15″ Venturi meter in the pumping station and the flow through the Ashland pipe line into the Sudbury Aqueduct will be measured by a 20″ x 10″ Venturi meter located at the Ashland Dam. The flow through the Whitehall pipe line can be rated by a weir at its outlet.

Surveys and studies were made to determine the feasibility of constructing a decolorizing plant at the outlet of the Hopkinton line into the Sudbury Reservoir. The outlet well at the end of the pipe line is designed so that it may, if required, serve the purpose of a mixing chamber.

Chlorinating apparatus installed in the pumping station at Cordaville will allow chlorination as required of either the pumpage from the Cordaville Woolen Company's mill pond or the gravity flow from the Hopkinton Reservoir. Similar chlorinating apparatus installed in the District's Framingham Gate House No. 1 will allow chlorination as required of the flow from Ashland Reservoir.

The following tabulation shows briefly the sources and extent of the additions to the supply of the District which have been made in the Southern Sudbury area:

	Drainage Area (Square Miles)	Pipe Line			
		Length (Feet)	Diameter (Inches)	Material	Capacity (M.G.D.)
Ashland Reservoir	6.43	–	–	–	–
Ashland to Framingham Res. No. 2	–	14,400[1]	24	C. I.	9
Total above Ashland Reservoir	6.43	–	–	–	–
Whitehall Reservoir	4.35	–	–	–	–
Whitehall to City Road	–	6,740	20	C. I.	6.5
City Road Diversion Reservoir	0.40	–	–	–	–
Hopkinton Reservoir	5.86	–	–	–	–
Hopkinton to Cordaville	–	7,000	30	C. I.	14
Cordaville to Sudbury Reservoir	–	8,130	30	Con.	
Total above Hopkinton Reservoir	10.61	–	–	–	–
Additional above Cordaville Intake	17.24	–	–	–	–
Branch from Cordaville Intake	–	945	30	Con.	21[2]

[1] Includes approximately 980 feet of 20-inch cast iron pipe.

[2] Pumped.

HOLDEN OFFICE, WACHUSETT-COLDBROOK TUNNEL DIVISION

The Wachusett-Coldbrook Tunnel Division office at Holden Center has had charge of the field work in connection with the Wachusett-Coldbrook Tunnel, and, during the greater part of the year until the Hardwick Office was established, the surveys and borings in connection with the Coldbrook-Swift Tunnel extension. This division has continued in charge of the borings along the entire tunnel line, but the surveys for the extension beyond Coldbrook have been taken over by the Coldbrook-Swift Tunnel Division, established in September. The latter Division has also taken over the direction of work at the site of Shaft 8.

Office Work

Traverse lines have been calculated and co-ordinates of the traverse points figured. Topography notes have been reduced and plotted, and contour maps drawn for each shaft site. Property calculations have been made and property plans of the properties along the tunnel line and at the shaft sites sent to the Headquarters Office for the preparation of taking plans. All survey data has been co-ordinated on the basis of the existing Wachusett system of rectangular co-ordinates with 50,000 added to the eastings.

Shaft cross-sections showing the progress of construction have been plotted and measured. Monthly estimates have been made for Contracts 1, 4, 8, 10 and 12.

Field Work

Taped traverse lines were run along the Central Massachusetts Railroad and the highways for a total distance of 33 miles to locate the shafts for the Wachusett-Coldbrook Tunnel, and a taped traverse of 28 miles was run to locate the shafts for the Coldbrook-Swift Tunnel extension. Topography was taken at the eight shaft sites on the Wachusett-Coldbrook Tunnel to determine the areas required for camp sites and for the extensive spoil banks required for disposal of the rock to be excavated from the tunnel. Detailed topography was taken at the sites for Shafts 1, 2, 3 and 4 to obtain information for studies for filtration and chlorination works for treating the drainage from the tunnel and camps. The center line of the tunnel between Shafts 1 and 8 was cut through and taped by precise methods, a distance of 13.2 miles, and a surface profile taken. Property surveys were made for takings of camp sites and spoil areas at the shafts and for a taking, 50 feet wide, along the center line of the tunnel.

In April, 1927, an agreement was reached with the United States Department of Commerce, Coast and Geodetic Survey, for co-operative effort in running a line of precise levels from Springfield to Boston. This increased the primary net work of the survey in this vicinity and also furnished the Commission the necessary benches along the Chicopee and Ware Rivers and in the vicinity of the tunnel line between the Wachusett Reservoir and Coldbrook.

Later, lines of precise levels were extended to each shaft site on the Wachusett-Coldbrook Tunnel. These levels were also continued to the location of shafts on the Coldbrook-Swift Tunnel extension. In the Swift River Valley also, precise levels were run for 155 miles and 92 bench marks set, under the direction of the Holden Office.

Surveys were made of the White Bros. mill property at Coldbrook, of the Rutland Worsted Co. mill property at West Rutland and of various other properties. Diamond drill borings for the subsurface investigations of the tunnel line were located and elevations of the ground surface taken at each boring. Lines and grades were given for construction work on Contracts 4, 8, and 12. Sixty stone bounds were set at property corners.

Progress of Contracts

Contract 1. — Contract 1 with the Pennsylvania Drilling Co., Pittsburgh, Pa., for borings along the line of the tunnel was continued until July 15, 1927, when a final estimate was made. Work done under this contract was as follows:

	Number of holes	Depth to Ledge	Depth in Ledge
Year ending Nov. 30, 1926	1	70.0	16.0
Year ending Nov. 30, 1927	63	3,097.8	1,570.5
Total	64	3,167.8	1,586.5

Of these 64 holes, 39 were for determining the location of the Wachusett-Coldbrook Tunnel and the construction shafts and 25 for the Coldbrook-Swift Tunnel extension.

The original estimate of quantities on the basis of which the contract was let in November, 1926, was approximate only and merely for the purpose of securing unit prices for the work. The extent of the subsurface investigations which would be required was not known at that time. The amount of work actually required from the contractor at these unit prices was more than double the amount of the original estimate. Still further work in scattered locations remained to be done and on July 15 a supplementary agreement was made with the Pennsylvania Drilling Company to continue core borings to the surface of sound bed rock at $4.50 per foot, and core borings in sound bed rock at $5.50 per foot. Under this agreement 31 holes have been drilled to date with a total depth to ledge of 1,969.7 feet and a total depth in ledge of 468.5 feet. Practically all these holes were required to determine a suitable location for the Coldbrook-Swift Tunnel extension.

The subsurface investigations revealed the fact that the rock bed of the Ware River drops from a point near the surface at the site of the diversion dam and Shaft 8 to an elevation over 200 feet lower and more than 160 feet below the surface at a point near Barre Plains. This fact made it necessary to thoroughly investigate the possibility of a deep rock gorge underlying the Prince River, a tributary of the Ware River from the north, and to locate the line of the tunnel further north than was originally planned. A sufficient number of borings, it is believed, have been completed along the line finally selected to insure an adequate cover of sound bed rock at the crossing of Prince River, Muddy Brook and all other points where the possibility of a deep glacial gorge in the bed rock appeared.

Gasoline driven drilling machines were used on this work. The average number of men employed was 1 operator and 2 laborers for each machine.

Contract 4. Contract 4, for sinking Shaft 5 for the Wachusett-Coldbrook Tunnel in the Town of Rutland, was awarded to James J. Coughlan & Sons, Inc., Boston, Massachusetts, on March 28, 1927. The first construction work consisted of grading at the shaft site and clearing for the camp. Timbering was not required during earth excavation but was placed after rock excavation was started. Wooden forms, made in four sections to the circle and 5 feet high, were used for the concrete lining. On November 30 excavation was in progress at the bottom of the shaft and had been completed to 8 feet above the tunnel invert.

Miscellaneous construction data:

	Shaft 5
Total depth of shaft	656 ft.
Depth of earth	19 ft.
Depth of rock	637 ft.
Contract awarded	March 28, 1927
Work begun	April 4, 1927
Earth excavation completed	May 7, 1927
Rock excavation begun	May 11, 1927
First concrete lining placed	July 5, 1927
Concrete lining completed	Nov. 26, 1927
Average weekly progress of excavation and concrete lining	19.8 ft.
Maximum depth of rock excavated in one week	47 ft.
Maximum weekly average pumpage (after sinking 300 ft.)	32 g.p.m.
Minimum weekly average pumpage (after sinking 300 ft.)	20 g.p.m.
Average number of men employed per day in two shifts	39

The plant equipment at Shaft 5 consisted of the following:

2 W. J. 3 Sullivan Compressors, 14″x 8¾″, delivering a total of 1,060 cu. ft. of air per min. with 2 Gen. Elec. 100 H. P. Motors.
1 Air Receiver Tank, 10′-0″x 3′-6″ diam.
1 Lidgerwood 1-drum Electric Hoist with Gen. Elec. 50 H. P. Motor. (This was transferred to Shaft 6 on Sept. 7, when a Flory 1-drum Electric Hoist with Gen. Elec. 75 H. P. Motor was installed.)
1 Ransome ½-yd. Concrete Mixer with Gen. Elec. 7½ H. P. Motor.
1 Reliance Stone Crusher and screen with Ridler 15 H. P. Motor.
1 Drill-sharpening Machine.
1 Oil Furnace with 5 H. P. Motor.
On May 24 a 40 ft. Wooden Head-frame was erected.

The following is a summary of the work done and materials furnished under the principal items of the contract during the year:

	Shaft 5
Earth excavation	177.2 cu. yds.
Rock excavation in shaft and tunnel	5,026. cu. yds.
Drainage in shaft	324. lin. ft.
Forms for shaft lining	633. lin. ft.
Concrete shaft lining	1,429. cu. yds.
Portland cement	1,754. bbls.

Contract 8. — Contract 8, for sinking Shafts 6 and 7 for the Wachusett-Coldbrook Tunnel in the Town of Rutland, was awarded to James J. Coughlan & Sons, Inc., Boston, Massachusetts, on May 24, 1927. The earth section in each shaft was timbered with 8″ x 8″ sets and 2″ lagging. Wooden forms for the concrete lining were used as at Shaft 5, Contract 4. On November 30 Shaft 6 had been excavated to 6 feet above the tunnel invert, and at Shaft 7 the tunnel had been excavated 123 feet towards Shaft 6 and 128 feet towards Shaft 8.

Miscellaneous construction data:

	Shaft 6	Shaft 7
Total depth of shaft	432 ft.	411 ft.
Depth of earth	29 ft.	25 ft.
Depth of rock	403 ft.	386 ft.
Contract awarded	May 24, 1927	May 24, 1927
Work begun	June 1, 1927	June 1, 1927
Earth excavation completed	July 9, 1927	June 25, 1927
Rock excavation begun	July 12, 1927	June 30, 1927
First concrete lining placed	Aug. 9, 1927	July 25, 1927
Concrete lining completed	Nov. 23, 1927	Oct. 25, 1927
Average weekly progress of excavation and concrete lining	16.5 ft.	18.6 ft.
Maximum depth of rock excavated in one week	35 ft.	35 ft.
Maximum weekly average pumpage (after sinking 150 ft.)	4 g. p. m.	15 g. p. m.
Minimum weekly average pumpage (after sinking 150 ft.)	0 g. p. m.	2 g. p. m.
Average number of men employed per day in two shifts	31	35

The plant equipment at Shaft 6 consisted of the following:

1 Stiff-legged Derrick with 40 ft. Boom.
1 Mead-Morrison 2-drum Steam Hoist with 25 H. P. Boiler.
2 Sullivan Compressors delivering 233 and 530 cu. ft. of air per min. with Westinghouse 50 and 100 H. P. Motors.
1 Ingersoll-Rand Gasoline Portable Compressor delivering 150 cu. ft. of air per min.
1 Air Receiver Tank, 10′–0″ x 3′–6″ diam.
1 Ransome ½-yd. Concrete Mixer.
On Sept. 7 a Wooden Head-frame was erected and the Lidgerwood Electric Hoist from Shaft 5 was installed.

The plant equipment at Shaft 7 consisted of the following:

1 Stiff-legged Derrick with 60 ft. Boom.
1 Mead-Morrison 2-drum Steam Hoist with 25 H. P. Boiler.
2 Sullivan Compressors delivering 233 and 530 cu. ft. of air per min. with Westinghouse 50 and 100 H. P. Motors.
1 Gasoline Portable Compressor delivering 220 cu. ft. of air per min.
1 Air Receiver Tank, 10′–0″ x 3′–6″ diam.
1 Rex Gasoline ½-yd. Concrete Mixer.
On August 10 a Wooden Head-frame was erected and the Steam Hoist replaced by a Flory 1-drum Electric Hoist with 50 H. P. Motor.

The following is a summary of the work done and materials furnished under the principal items of the contract during the year:

	Shaft 6	Shaft 7
Earth excavation	273.3 cu. yds.	230.9 cu. yds.
Rock excavation in shaft and tunnel	3,174. cu. yds.	4,769. cu. yds.
Drainage in shaft and tunnel	211. lin. ft.	324. lin. ft.
Forms for concrete lining	413. lin. ft.	392. lin. ft.
Concrete shaft lining	960. cu. yds.	908. cu. yds.
Portland cement	1,054. bbls.	1,105. bbls.

Contract 10. — Contract 10, for constructing, maintaining and operating a 22,000-Volt Transmission Line in the Towns of West Boylston, Holden, Rutland, Oakham and Barre, was made with the New England Power Company, Worcester, Mass., on April 27, 1927. This line extends from West Boylston to Shaft 1 and from there generally over the tunnel line to Shaft 8. A transformer sub-station was constructed at the connection to the Power Company's 66,000 volt line in West Boylston.

Work was started immediately on clearing for the transmission line which was built, from West Boylston to Shaft 2, on property of the Commonwealth. From Shaft 2 to Shaft 8, the line was over the 50-ft. taking on the center line of the tunnel, which was cleared for the full width of 50 feet. A three-wire transmission line was erected on wooden poles from 35 to 40 feet in height. The work was performed with all possible speed and was completed, with the line energized, on June 20.

The average number of men employed per day was 69.

Contract 12. — Contract 12, for sinking Shafts 2, 3 and 4 for the Wachusett-Coldbrook Tunnel in the Towns of Holden and Rutland, was awarded to the Dravo Contracting Co., Pittsburgh, Pa., on May 24, 1927. The earth sections at Shafts 2 and 4 were timbered with 8″ x 8″ sets spaced 5 feet apart and 2″ lagging. At Shaft 3 a reinforced concrete caisson was sunk to ledge. This caisson was 14.5 feet inside diameter, with a thickness of 32″, and was built in 8-foot sections. The bottom section was equipped with a steel shoe for a cutting edge. Wooden forms were used for the concrete lining.

A modification of Contract 12 was made October 25, 1927, with the Dravo Contracting Co. authorizing, at a modified price, tunnel excavation by the Contractor beyond the limits set by the original contract.

On November 30 the tunnel at Shaft 2 had been excavated 213 feet towards Shaft 1 and 230 feet towards Shaft 3. At Shaft 3 excavation had been completed to 4 feet above the tunnel invert, and at Shaft 4 excavation had been completed to 17 feet above the tunnel invert.

Miscellaneous construction data:

	Shaft 2	Shaft 3	Shaft 4
Total depth of shaft	313 ft.	339 ft.	457 ft.
Depth of earth	25 ft.	61 ft.	23 ft.
Depth of rock	288 ft.	278 ft.	434 ft.
Contract awarded	May 24, 1927	May 24, 1927	May 24, 1927
Work begun	June 14, 1927	June 8, 1927	June 8, 1927
Earth excavation completed	July 1, 1927	Aug. 18, 1927	July 9, 1927
First section of caisson poured		July 20, 1927	
Concrete caisson completed		Aug. 18, 1927	
Rock excavation begun	July 1, 1927	Aug. 18, 1927	July 9, 1927
First concrete lining placed	July 15, 1927		July 25, 1927
Concrete lining completed	Sept. 22, 1927	Nov. 12, 1927	Nov. 30, 1927
Average weekly progress of excavation and concrete lining	21.1 ft.	19.2 ft.	19.2 ft.
Maximum depth of rock excavated in one week	41 ft.	40 ft.	31 ft.

	Shaft 2	Shaft 3	Shaft 4
Maximum average weekly pumpage (after sinking 100 ft.)	10 g. p. m.	8 g. p. m.	100 g. p. m.
Minimum average weekly pumpage (after sinking 100 ft.)	10 g. p. m.	0 g. p. m.	60 g. p. m.
Average number of men employed per day in two shifts	35	24	37

The plant equipment at Shaft 2 consisted of the following:

1 Steel Stiff-legged Derrick with a 50 ft. Boom.
1 Lambert 2-drum Electric Hoist with Swinging Engine and a Westinghouse 82 H. P. Motor.
2 Ingersoll-Rand Air Compressors delivering 446 and 528 cu. ft. of air per min. with Gen. Elec. 104 and 100 H. P. Motors.
1 Air Receiver Tank, 11′–0″ x 4′–0″ diam.
1 Lakewood ¾-yd. Concrete Mixer with an Allis-Chalmers 15 H. P. Motor.

The plant equipment at Shaft 3 consisted of the following:

1 Lambert 3-drum Hoist with Swinging Engine run by compressed air.
1 Lambert 1-drum Electric Mine Hoist with Westinghouse 100 H. P. Motor.
2 Ingersoll-Rand Compressors delivering 446 and 324 cu. ft. of air per min. with Gen. Elec. 75 and 50 H. P. Motors.
1 Air Receiver Tank, 8′–0″ x 3′–0″ diam.
1 Koehring ¾-yd. Concrete Mixer with Westinghouse 15 H. P. Motor.
1 Steel Stiff-legged Derrick with 45 ft. Boom and a 34 ft. Steel Head-frame.

The plant equipment at Shaft 4 consisted of the following:

1 Lambert 2-drum Steam Hoist with 50 H. P. Steam Boiler.
1 Thomas Elevator Co. 2-drum Electric Hoist with a Wagner 90 H. P. Motor.
2 Ingersoll-Rand Compressors delivering 546 and 324 cu. ft. of air per min. with Westinghouse 60 and 100 H. P. Motors.
1 Air Receiver Tank, 10′–4″ x 5′–0″ diam.
1 Marsh-Capron ¾-yd. Concrete Mixer.
1 Drill Sharpening Machine.
1 Oil Furnace.
1 Stiff-legged Derrick with 45 ft. Boom which was used with the Steam Hoist until the Shaft reached a depth of 65 ft. Then a 40 ft. Wooden Head-frame was erected and the Electric Hoist used.

The following is a summary of the work done and materials furnished under the principal items of the contract during the year:

	Shaft 2	Shaft 3	Shaft 4
Earth excavation	231.8 cu. yds.	693.4 cu. yds.	214.9 cu. yds.
Rock excavation in shaft and tunnel .	5,329. cu. yds.	2,394. cu. yds.	3,316. cu. yds.
Drainage in shaft and tunnel . .	369. lin. ft.	166. lin. ft.	220. lin. ft.
Forms for concrete lining . .	291.1 lin. ft.	327. lin. ft.	441. lin. ft.
Concrete shaft lining	682.8 cu. yds.	956. cu. yds.	1,022. cu. yds.
Portland cement	920. bbls.	1,258. bbls.	1,414. bbls.
Chlorine	–	–	35 lbs.
Chlorine dosing machine	1	1	1
Drilling holes in rock	–	–	364 ft.
Grout	–	–	14 cu. yds.

HARDWICK OFFICE, COLDBROOK-SWIFT TUNNEL DIVISION

The Coldbrook-Swift Tunnel Division office at Hardwick was established in September, 1927. It has taken over the direction of surveys in connection with the proposed Coldbrook-Swift Tunnel extension, including the site of Shaft 8. The borings for the entire tunnel, however, have remained under the direction of the Wachusett-Coldbrook Tunnel Division office at Holden.

Office Work

Topography notes have been reduced and plotted, traverses have been calculated, cross-sections in the vicinity of Shaft 8 have been plotted and deeds of properties along the proposed Coldbrook-Swift Tunnel extension line have been copied. A plan of the entire line from Shaft 8 to the Portal in the vicinity of East Pond in Greenwich on a scale of 1″ = 400′ was begun, and also plans of topography at the sites of Shafts 9, 10 and 11.

Field Work

Field work was started on September 20. Approximately 20 miles of stadia traverse lines were run and 70 acres of topography taken, including the sites of Shafts 9, 10 and 11 of the Coldbrook-Swift Tunnel extension. The approximate location of the center line of this tunnel was laid out as proposed when work on this Division was first started in September, and also the more northerly location that was selected when the results of borings indicated that there would probably not be sufficient depth of sound rock cover for the tunnel in the location first selected. Field work for property takings was started.

ENFIELD OFFICE, SWIFT RIVER RESERVOIR DIVISION

The Swift River Reservoir Division office at Enfield has had charge of the field work in the Swift River Valley in connection with the proposed Swift River Reservoir.

Office Work

Topography notes have been reduced and approximately 6,300 acres have been plotted to a scale of 1″ = 200′ on record mounted plans. Maps on a scale of 1″ = 400′ of the towns of Enfield, Greenwich, and Dana have been made showing the approximate ownership of lands in these towns. These maps were made with the assistance of the Assessors of the various towns for the purpose of aiding the title examiners of the Commission in the search of records. A general map of the area which may be affected by the Swift River Reservoir was prepared from existing maps and information obtained by aerial photographs on a scale of 1″ = 1,000′ for the purpose of showing property acquired by the Commission and from time to time such properties have been located on this map.

Computations have been made of the triangulation system and co-ordinates of all points figured on the rectangular co-ordinate system which was adopted for the area affected by the Swift River Reservoir and the tunnel as far east as Coldbrook. In this system the co-ordinate plane is tangent to the spheroid of the earth at the point whose latitude is N 42° 22′ 30″ and whose longitude is 72° 18′ 00″ west of Greenwich. The co-ordinate axes are straight lines tangent at this point to the meridian and a great circle at right angles to it. The rectangular co-ordinates of this tangent point are N 86,166.56 and E 98,807.57.

Field Work

A major triangulation control system based upon a base line measurement in the town of Greenwich and including the erection of permanent signals covering the area of all probable survey work for the Swift River Reservoir was completed on June 24, 1927.

Topographic surveys of the dam and dike sites were made, together with similar surveys of portions of the reservoir area, covering a total of approximately 11,500 acres or 18 square miles. About 4,200 acres of real estate were surveyed, a large part of which has been acquired by the Commission. Approximate location was made of property lines along that part of the Coldbrook-Swift Tunnel extension to be located within the area which may be affected by the Swift River Reservoir. Photographs of 98 buildings acquired by the Commission, or offered for sale to the Commission, were taken for record.

Permanent bench marks, connected by precise levels to those established by the Holden office in co-operation with the U. S. Coast and Geodetic Survey, were established throughout the Swift River Valley for control of all topographic work.

A census was made of burials in all cemeteries which may be affected by the Swift River Reservoir. The work of copying inscriptions and locating each headstone or monument has been partially completed.

Surveys were made for the proposed temporary diversion dam below Greenwich Lake. The Sunk brook swamp area lying north of the Beaver Brook divide was sounded and a possible high water line resulting from the flowage which may be caused by the temporary diversion dam was located.

This Division co-operated with the Holden office in supervision of borings under Contract 1, with the Pennsylvania Drilling Co., in the exploration of possible tunnel portal sites on the westerly end of the Coldbrook-Swift Tunnel extension at the Swift River Reservoir.

Progress of Contracts

Contract 2. — Contract 2, for borings at the proposed dam and dike sites, was completed and a final estimate made on June 3, 1927. A total of 58 holes were drilled of which 26 were for determining the location and character of bed rock and overlying material at the site of the dike and 32 were for the main dam. The total depth drilled was 6,180.6 feet, of which 5,050.8 feet were in overburden and 1,129.8 feet in bedrock.

FRAMINGHAM OFFICE, SOUTHERN SUDBURY EMERGENCY SUPPLY

The Southern Sudbury Emergency Supply office at Framingham has had charge of the field work in connection with the preliminary surveys, final location and construction of the various projects required for the diversion of water from the headwaters of the Southern Sudbury drainage area directly into the Sudbury Reservoir or the Sudbury Aqueduct.

Office Work

Much preliminary information was obtained from plans of the original Boston Water Works on file in the office of the Metropolitan District Commission. Topography notes were reduced and plotted. Plans of the properties required along the pipe lines and for other structures were sent to the Headquarters office for the preparation of taking plans. Monthly estimates were made for Contracts 5, 6, 7, 11, 13 and 16.

Field Work

About 18 miles of levels were run to establish benches for use in taking topography and running profiles for the various pipe lines. Most of the topography, as well as the preliminary traverse lines, was surveyed by stadia. Approximately 21.4 miles of stadia traverses were run and 780 acres of topography taken. Rod soundings were made and numerous test pits dug to determine the nature of the material to be encountered in excavation.

Progress of Contracts

Contract 5. — Contract 5, for constructing a 30-inch pipe line from Cordaville to Sudbury Reservoir in the Town of Southborough, was awarded to the Lock Joint Pipe Company, Ampere, New Jersey, on April 15, 1927. The award was made for reinforced concrete cylinder pipe. This pipe was manufactured at the Contractor's plant at Ampere, New Jersey, and shipped by rail to Cordaville. Most of the excavation was made by a Speeder gasoline shovel with a $\frac{1}{2}$-yard ditcher bucket. A four-wheel laying rig was used where possible for placing the pipe, the remainder being placed by the Speeder shovel.

Miscellaneous construction data:

Length of line	9,000 ft.
Size of pipe	30 in.
Width of taking, main part of line	30 ft.
Contract awarded	April 15, 1927
Work begun	June 6, 1927
Average length of pipe laid per week	488 ft.
Maximum length of pipe laid per week	999 ft.
Leakage, from "Y" connection with Contract 7 to outlet, in gal. per day per in. diam. per mi. of pipe [1]	139.4
Test made	Oct. 7, 1927
Leakage, from intake to "Y" connection with Contract 7, in gal. per day per in. diam. per mi. of pipe	41.6
Test made	Nov. 22, 1927
Average number of men employed per day	20

The contract was nearly completed on November 30, 1927, and the following is a summary of the work done and materials furnished under the principal items of the contract during the year:

Furnishing and laying 30-inch concrete pipe	8,779 ft.
Furnishing and laying 18-inch cast iron pipe	220 ft.
Furnishing and laying 12-inch cast iron pipe	269 ft.
Earth excavation, fill and refill	8,980 cu. yds.
Rock excavation and refill	366 cu. yds.

Contract 6. — Contract 6, for constructing a pumping station in the Town of Southborough, was awarded to F. A. Mazzur Co. Inc., Boston, Mass., on May 2, 1927. Hand excavation for the foundation was started on May 26 and the con-

crete foundation was completed June 15. The 250-H. P. pumping unit, consisting of a 20″ Worthington Centrifugal Pump and a General Electric Motor, was installed on August 19.

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[1] Includes the leakage from the by-pass piping at the Cordaville Pumping Station, Contract 6, and the "Y" connection with Contract 7.

The permanent power connection to the 2,200 volt line of the Marlborough Electric Company was made on October 15 and the acceptance test of the main pumping unit was run on October 18.

Chlorinating apparatus was furnished and installed by the Commission in the pumping station erected under Contract 6. The chlorinator pump did not deliver a uniform flow when first tested on October 6, nor in any subsequent tests, and a new pump of the same type but with air chambers was installed on November 11, and has performed satisfactorily.

Contract 7. — Contract 7, for constructing a 30-inch pipe line from Hopkinton Reservoir to Cordaville in the Towns of Ashland and Southborough, was awarded to Cenedella & Co., Milford, Mass., on May 4, 1927. The award was made for cast iron pipe. The pipe was shipped by rail from the Warren Foundry and delivered at the Cordaville Station. Practically all the trench excavation was made by two Erie steam shovels with ¾-yard buckets before any pipe was laid. These shovels were also used to place the pipe. Lead hydrotite was used in pouring the joints.

At the Sudbury River crossing it was necessary to bring in some selected material for backfill under and around the pipe. Lead joints were used for the pipe for the full length of the river crossing. The river was diverted during construction by a channel excavated about 100 feet west of the natural river bed.

Miscellaneous construction data:

Length of line	7,000 ft.
Size of pipe	30 in.
Width of taking	40 ft.
Contract awarded	May 4, 1927
Work begun	May 9, 1927
Average length of pipe laid per week	634 ft.
Maximum length of pipe laid per week	1,793 ft.
Leakage in gal. per day per in. diam. per mi. of pipe	117.8
Test made	Sept. 28, 1927
Average number of men employed per day	22

The contract was nearly completed on November 30, 1927, and the following is a summary of the work done and materials furnished under the principal items of the contract during the year:

Furnishing and laying 30-inch cast iron pipe	6,977 ft.
Excavation	12,273 cu. yds.
Furnishing and placing paving	80 cu. yds.
Furnishing and placing riprap	267 cu. yds.
Furnishing and placing concrete	43 cu. yds.
Furnishing and placing 18-inch cast iron culvert pipe	120 ft.

Contract 11. — Contract 11, for constructing a 24-inch pipe line from Ashland Reservoir to gate house at Framingham Reservoir No. 2 in the Towns of Ashland and Framingham, was awarded to Antonio Mogavero, Peabody, Mass., June 3, 1927. The award was made for cast iron pipe. The excavation, laying of pipe and backfilling were each carried on continuously. The excavation and pipe laying was done by a ½-yard Bay City gasoline excavator and a considerable part of the backfill was done with a Fordson Tractor with two cables pulling material into the trench with hand scrapers. Lead hydrotite was used for the joints.

Framingham Reservoirs Nos. 1 and 2 were drawn down by the Metropolitan District Commission in order to facilitate the construction where the line crosses these reservoirs. Very little muck was found on the bottom of the Reservoir No. 2 at the lower crossing. This was removed for laying the pipe and levelled with gravel which was obtained in the basin. The upper crossing of Reservoir No. 2 was done when the water was very low and was carried on one-half at a time by means of sandbag cofferdams.

Miscellaneous construction data:

Length of line	14,400 ft.
Size of pipe	20 and 24 in.
Width of taking	40 ft.
Contract awarded	June 3, 1927

Work begun	June 6, 1927
Average length of 24″ pipe laid per week	790 ft.
Average length of 20″ pipe laid per week	192 ft.
Maximum length of 24″ pipe laid per week	1,418 ft.
Maximum length of 20″ pipe laid per week	622 ft.
Leakage in gal. per day per in. diam. per mi. of pipe	136.3
Test made	Nov. 29, 1927
Average number of men employed per day	28

This contract was nearly completed on November 30, 1927, and the following is a summary of the work done and the materials furnished under the principal items of the contract during the year:

Furnishing and laying 24″ cast iron pipe	13,439 ft.
Furnishing and laying 20″ cast iron pipe	967 ft.
Earth excavation, fill and refill	11,000 cu. yds.
Rock excavation and refill	631 cu. yds.
Furnishing and placing riprap	38 cu. yds.
Furnishing and placing concrete	70 cu. yds.

Contract 13. — Contract 13, for constructing a 20-inch pipe line from Whitehall Reservoir to a diversion dam on City Brook in the Town of Hopkinton, was awarded to the Portland Contracting Co. Inc., Portland, Maine, on July 15, 1927. The diversion dam was built first. The impervious core was obtained by stripping by hand the soil from the area north of the reservoir site and adjacent to the dam site. Pervious embankment was obtained from a borrow pit about 1,000 feet away and just off City Road.

Approximately 3,025 feet of trench was excavated by a ½-yard Bay City excavator, the remainder being done by hand except for rock excavation. An Ingersoll-Rand compressor with jack hammers was used for drilling the rock.

Miscellaneous construction data:

Length of line	6,740 ft.
Size of pipe	20 in.
Width of taking	40 ft.
Contract awarded	July 15, 1927
Work begun	July 25, 1927
Average length of pipe laid per week	438 ft.
Maximum length of pipe laid per week	1,265 ft.
Average number of men employed per day	24

This contract was nearly completed on November 30, 1927. There remained about 470 feet of pipe to be laid and some miscellaneous work to be done. The following is a summary of the work done and materials furnished under the principal items of the contract during the year:

Furnishing 20-inch cast iron pipe	6,660 ft.
Laying 20-inch cast iron pipe	6,350 ft.
Excavation, fill and refill	4,600 cu. yds.
Excavation at diversion dam	464 cu. yds.
Furnishing and placing impervious core and blanket at diversion dam	730 cu. yds.
Furnishing and placing pervious embankment	1,590 cu. yds.
Furnishing and placing soil dressing	159 cu. yds.
Furnishing and placing concrete	50 cu. yds.
Furnishing and placing paving	25 cu. yds.

Contract 16. — Contract 16, for clearing and excavating open channel from the reservoir formed by the diversion dam on City Brook to Hopkinton Reservoir in the Town of Hopkinton, was awarded to the Sanders Engineering Co., Portland, Maine, on September 23, 1927. The clearing was done in the usual way, a small amount of wood and timber being salvaged. The stumps in the grubbing operation were removed by pulling with a steam hoisting engine. Excavation for the channel was started at the lower end. A gasoline shovel with a one-yard drag line bucket was used. This shovel was carried on pontoons between the channel and a spoil bank on the north side of the channel.

Miscellaneous construction data:

Length of channel	5,000 ft.
Contract awarded	Sept. 23, 1927
Width of taking	150 ft.
Work begun	Oct. 4, 1927
Average area of land cleared per week	3.3 a.
Average area of land grubbed per week	1.0 a.
Average length of channel excavated per week	900 ft.
Maximum length of channel excavated per week	1,125 ft.
Average number of men employed per day	24

Approximately 750 feet of channel remained to be excavated and miscellaneous work to be completed on November 30, 1927. The following is a summary of the work done and materials furnished under the principal items of the contract during the year:

Clearing	25.2 a.
Grubbing	7.0 a.
Excavation	13,500 cu. yds.
Furnishing and placing concrete	31 cu. yds.

GEOLOGIC DATA

Chapter 321, Acts of 1927, provides that the Commission shall collect and publish in its reports such information as to the geology of the region in which any of the works which it is authorized to construct may be located as may be of value in connection with the geological history of the state. Such information, obtained from sub-surface investigations and construction to date, is as follows:

Surficial Geology. — The line of the Wachusett-Swift Tunnel traverses a portion of the central upland or Worcester County Plateau, recognized as the base level of erosion during the Cretaceous Period. Since the Cretaceous Period, the plateau or peneplain has been dissected by renewed stream action as the result of uplift, and the topography resulting therefrom considerably modified by continental glaciation. The accumulated results of these geologic processes have had a decided effect on the location of the tunnel in direction and in depth. The earth mantle, which obscures the underlying rock formations, is of glacial origin, and occurs as unmodified and modified drift deposits. The unmodified drift is found mostly in the areas covered with the ground moraine, which is confined to the higher elevations, while the modified drift is found entirely in the valleys. The latter deposits were of great importance because of their deposition to unknown depths. Numerous borings, drilled through the modified drift of Glacial Lake Nashua, within the valley of the Quinapoxet River, found bedrock at such a low elevation as to make it necessary to depress the tunnel. The lowest elevation of rock in this area was found at Elevation 373 at the location of Shaft 1, the outlet from the tunnel into the Wachusett Reservoir at the Quinapoxet River basin. This elevation is probably not much higher than the lowest rock in the pre-glacial gorge of the Quinapoxet River. The drift within the valley has been deeply eroded by the present stream, so that the depth of cover determined from numerous borings does not indicate the total depth of glacial deposition in this area. One hole in particular penetrated 114 feet of material and it is quite probable that the original drift in some sections was deposited to a depth of 175 feet or more.

Several borings across the Ware River at Smithville, or White Valley, located the lowest rock in the pre-glacial channel of the Ware River at Elevation 607, which is approximately 40 feet lower than the flow line of the present river. The deepest drift is confined to the south side of the valley, and the deepest hole penetrated 93 feet of material before locating bedrock. Within the same valley, but approximately 3 miles west, at the junction of the Prince River and the Ware River, rock was found as low as Elevation 434, with a corresponding depth of earth cover of 162 feet. A complete profile across the Ware River valley, at this point, was not obtained, and it is quite probable that more holes would have shown rock as low as Elevation 400. Other borings, ¾ mile north of this point, but confined to the Prince River valley, indicate that the low rock in the Ware River valley is possibly due to glacial scour and over-deepening of the pre-glacial Ware River valley in this vicinity. The deepest hole on the tunnel line, crossing the Prince River valley, and located in the middle of the valley, penetrated 108 feet of fine-medium sand and boulders before locating rock at Elevation 482. Borings on two tentative lines in the spacious valley now occupied by Muddy Brook indicate that it, too, has its origin in a pre-glacial or inter-glacial river, which obtained its flow from a part of the present Swift River watershed. The reversal of drainage is due to the blocking of the valley by glacial drift, in some places as deep as 135 feet or more. A similar condition exists in Beaver Brook valley, at the dike site, where the lowest rock along the axis was found at Elevation 290, buried to a depth of 142 feet. The Swift River, at the main dam site, flows approximately 130 feet above its pre-glacial channel.

Geologic Formations. — The rocks, along the tunnel line from the Wachusett Reservoir to the dam and dike sites in the Swift River valley, are of several varieties, but in their simplest terms are found to be primarily of the following types:

1. Quartz-mica phyllite, a fine-grained, finely-laminated quartzose rock with variable amounts of mica.
2. Biotite-muscovite granite of medium grain.
3. Quartz-mica schist, a medium-grained, strongly quartzose, more or less distinctly laminated and micaceous rock.
4. Mixed injection schist, an intimate mixture of the quartz-mica schist and phyllite with the granite.
5. Grayish white medium-grained biotite-granite gneiss with differentiation facies to high hornblende-biotite and high quartz rocks.
6. Hornblende-diorite, a differentiation facies of the granite gneiss.

The areal extent of these formations is partly obscured in the field by the glacial drift, and it is quite impossible, at this date, to draw exact boundaries, but their occurrence along the line is in the order named. The structural relations are obscure and uncertain. In the six shafts constructed, the structure was surprisingly flat, and at no shaft has the structure stronger slopes than forty-five degrees. The rock is considerably jointed, some joints of which show rather strong slickensided effects. The rock at Shaft 5, which is a quartz-mica schist, remained of the same character, with the structure horizontal, for the total depth of the shaft. The geologic age of the various formations is problematical, but it is certain that the granite is the younger rock, and that the schists are older metamorphosed sediments.

Due to the difference of opinion as to the geologic age and structural relations of the several rock formations in this area, the intention is to collect and study data obtained from the excavations in the shafts and tunnel. This data, when complete, will give a cross section of the rock formations of Central Massachusetts for a distance of 25 miles or more.

List of Drawings and Tables

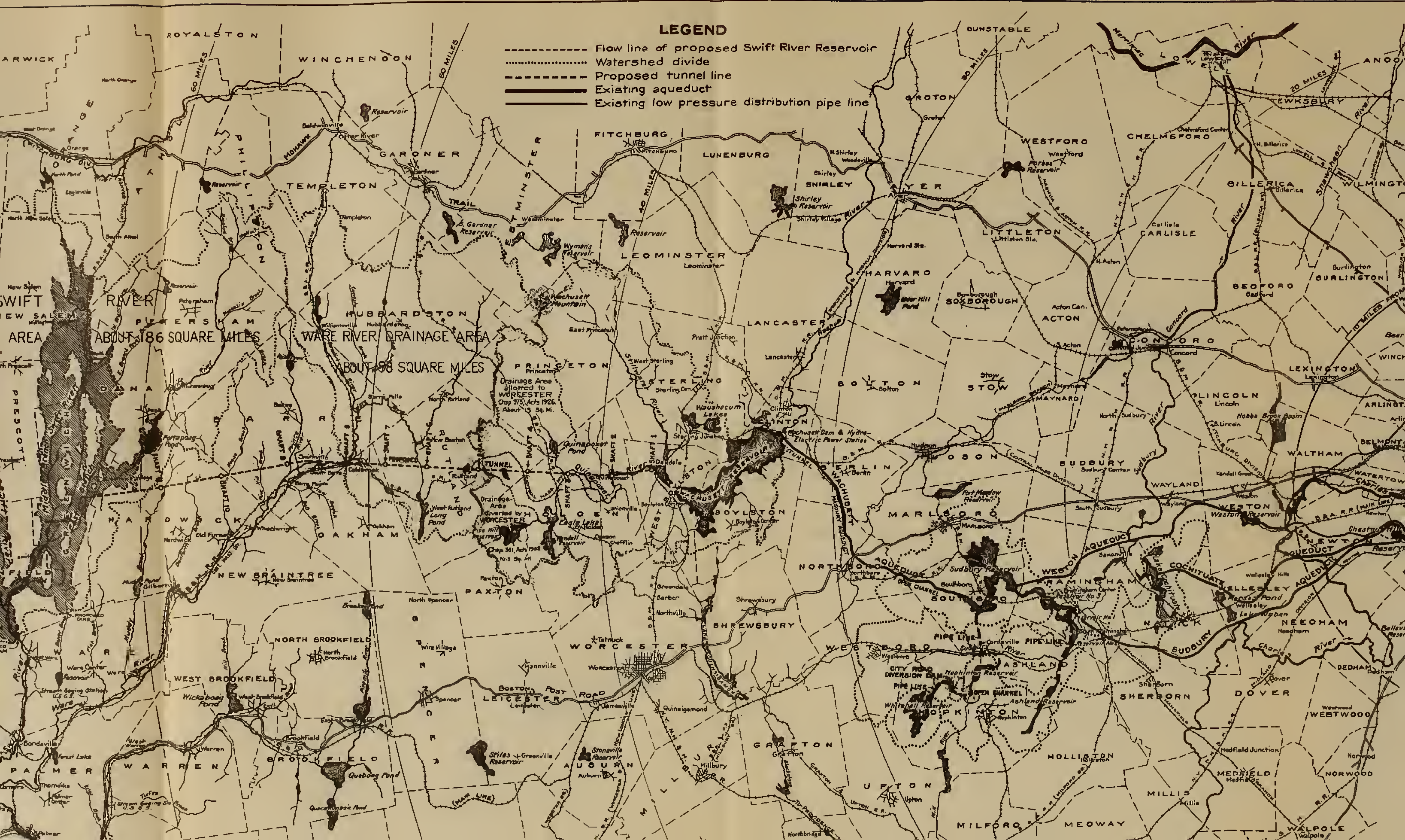
The following drawings and tabulations are appended to this report:

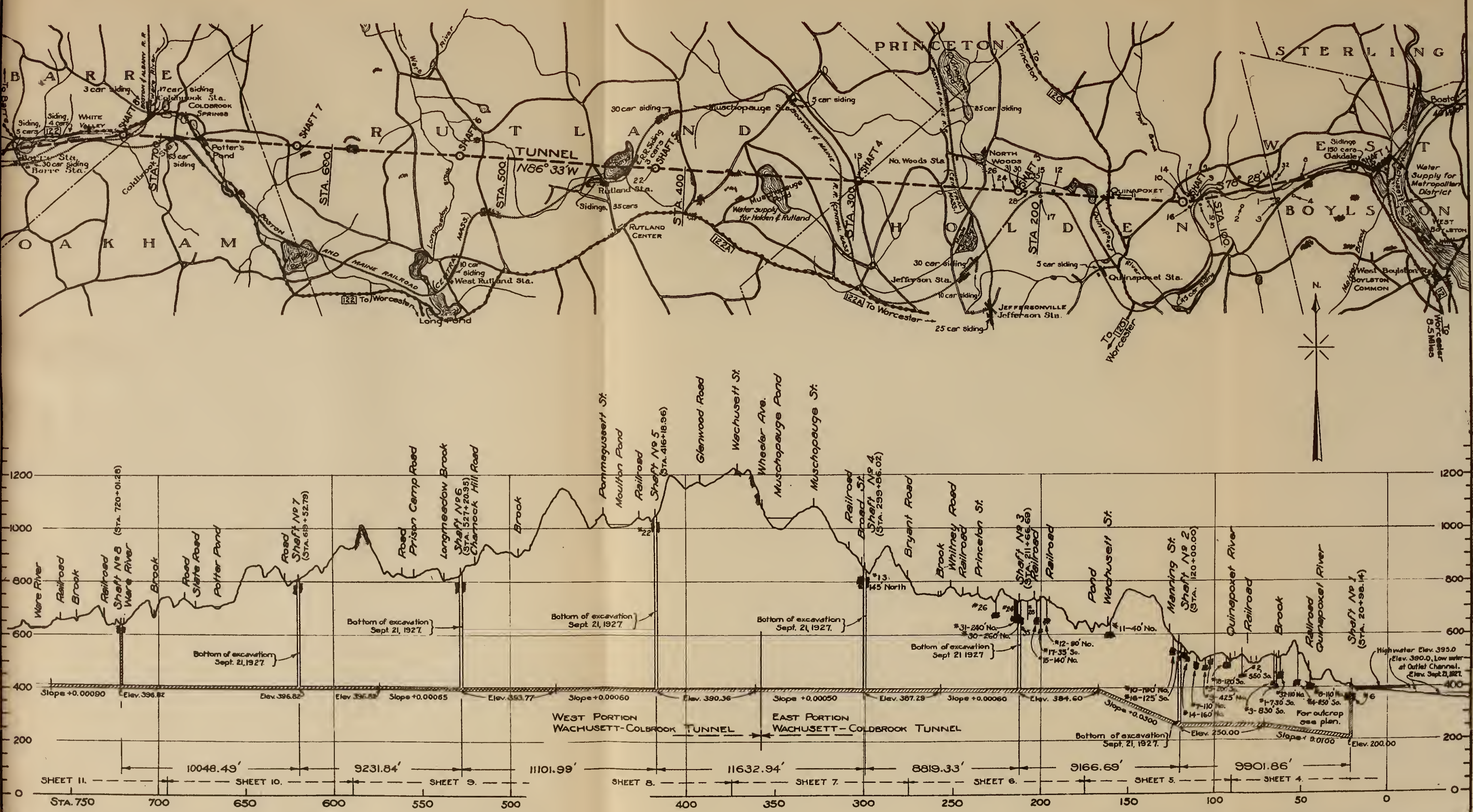
General Plan of Metropolitan Water Supply.
Key Plan and Profile, Wachusett-Coldbrook Tunnel.
Monthly Progress — Real Estate Acquired for the Wachusett-Coldbrook Tunnel.
Location of Real Estate Acquired for the Wachusett-Coldbrook Tunnel.
Monthly Progress — Real Estate Acquired for the Southern Sudbury Emergency Supply.
Location of Real Estate Acquired for the Southern Sudbury Emergency Supply.
Monthly Progress — Real Estate Acquired for the Swift River Reservoir.
Location of Real Estate Acquired for the Swift River Reservoir.
Status of Contracts Executed to November 30, 1927.
Total Value of Work Estimated under Contracts in Progress During Year Ending November 30, 1927.
Canvass of Bids, Contract 4.
Canvass of Bids, Contract 5.
Canvass of Bids, Contract 6.
Canvass of Bids, Contract 7.
Canvass of Bids, Contract 8.
Canvass of Bids, Contract 11.
Canvass of Bids, Contract 12.
Canvass of Bids, Contract 13.
Canvass of Bids, Contract 16.

Respectfully submitted,

FRANK E. WINSOR,
Chief Engineer.

24 School Street, Boston, Mass.
December 1, 1927.


LEGEND
Flow line of proposed Swift River Reservoir
Watershed divide
Proposed tunnel line
Existing aqueduct
Existing low pressure distribution pipe line
SWIFT RIVER AREA ABOUT 186 SQUARE MILES
WARE RIVER DRAINAGE AREA ABOUT 98 SQUARE MILES
Drainage Area allotted to WORCESTER Chap. 375, Acts 1926. About 13 Sq. Mi.
Drainage Area diverted by WORCESTER Chap. 301, Acts 1902 No. 3 Sq. Mi.
TUNNEL
SHAFT 1
SHAFT 2
SHAFT 3
SHAFT 4
SHAFT 5
SHAFT 6
SHAFT 7
SHAFT 8
SHAFT 9
SHAFT 10
20 MILES
30 MILES
40 MILES
50 MILES
60 MILES
10 MILES FROM
ROYALSTON
WINCHENDON
DUNSTABLE
WARWICK
ORANGE
TEMPLETON
GARDNER
WESTMINSTER
FITCHBURG
LUNENBURG
SHIRLEY
AYER
GROTON
WESTFORD
CHELMSFORD
LOWELL
TEWKSBURY
BILLERICA
WILMINGTON
CARLISLE
LITTLETON
LEOMINSTER
HARVARD
BOXBOROUGH
ACTON
BEDFORD
BURLINGTON
CONCORD
LEXINGTON
LINCOLN
PETERSHAM
PHILLIPSTON
HUBBARDSTON
PRINCETON
STERLING
LANCASTER
CLINTON
BOLTON
STOW
MAYNARD
SUDBURY
WALTHAM
WAYLAND
WESTON
NEW SALEM
DANA
PRESCOTT
HARDWICK
BARRE
RUTLAND
OAKHAM
HOLDEN
WEST BOYLSTON
BOYLSTON
BERLIN
HUDSON
MARLBORO
NORTHBORO
SOUTHBORO
FRAMINGHAM
NATICK
WELLESLEY
NEWTON
NEEDHAM
NEW BRAINTREE
PAXTON
SHREWSBURY
WESTBORO
ASHLAND
SHERBORN
DOVER
NORTH BROOKFIELD
SPENCER
LEICESTER
WORCESTER
WEST BROOKFIELD
WARE
PALMER
WARREN
BROOKFIELD
AUBURN
MILLBURY
GRAFTON
UPTON
HOPKINTON
HOLLISTON
MILLIS
MEDFIELD
NORWOOD
WESTWOOD
DEDHAM
MILFORD
MEDWAY
WALPOLE
SWIFT RIVER
WARE RIVER
Quinapoxet River
Wachusett Reservoir
Nashua River
Sudbury River
Concord River
Charles River
Merrimac River
Shawsheen River
Wachusett Mountain
Mohawk Trail
Boston Post Road
Wachusett Aqueduct
Weston Aqueduct
Sudbury Aqueduct
Cochituate Aqueduct
Sudbury Reservoir
Framingham Reservoir No. 3
Lake Cochituate
Weston Reservoir
Hopkinton Reservoir
Ashland Reservoir
Whitehall Reservoir
Fort Meadow Reservoir
Quabbin Pond
Brooks Pond
Quinapoxet Pond
Waushacum Lakes
Forbes Reservoir
Shirley Reservoir
Bear Hill Pond
Wyman's Reservoir
S. Gardner Reservoir
Stiles Reservoir
Stoneville Reservoir
Wickaboag Pond
Long Pond
Pottapaug Pond
Eagle Lake
Kendall Reservoir
Pine Hill Reservoir
Hobbs Brook Basin
Lake Waban
Harvey Pond
Wachusett Dam & Hydro-Electric Power Station
CITY ROAD DIVERSION DAM
PIPE LINE
OPEN CHANNEL
Stream Gaging Station U.S.G.S.
PROPOSED DIKE
B. & M. R. R.
B. & A. R. R. (MAIN LINE)
N. Y. N. H. & H. R. R.
CENTRAL MASS DIVISION
FITCHBURG DIV.



NOTE :— Elevations — Boston City Base.

LEGEND

- 8⚬ Borings shown on plan.
- ▪ #8-110' No. Borings shown on profile.
- ▨ Rock outcrops on plan or profile.
- [12] Hard surfaced roads, with route numbers.

COMMONWEALTH OF MASSACHUSETTS
METR. DISTR. WATER SUPPLY COMMISSION

WACHUSETT – COLDBROOK TUNNEL

KEY PLAN AND PROFILE

3000 1500 0 3000 6000 FT.

SEPT. 21, 1927.

COMMONWEALTH OF MASSACHUSETTS
METR. DISTR. WATER SUPPLY COMMISSION
MONTHLY PROGRESS — REAL ESTATE ACQUIRED FOR THE WACHUSETT-COLDBROOK TUNNEL.

DATE	TAKING PLANS PREPARED	TAKEN IN FEE (Acres)	EASEMENT FOR TUNNEL (Acres)	EASEMENT FOR POWER LINE (Acres)	EASEMENT FOR TUNNEL AND POWER LINE (Acres)	EASEMENT FOR SURFACE R. of W. (Acres)	FEE & EASEMENT IN COMMONWEALTH (Acres)
December 1926							
January 1927							
February							
March							
April	4						
May	6						
June	2						
July		188.34	0.67	1.43	1.05	0.78	192.27
August		96.67	0.98	7.43	0.98	1.53	107.59
September							
October	2						
November		284.83			0.84		285.67
Total	14	569.84	1.65	8.86	2.87	2.31	585.53

COMMONWEALTH OF MASSACHUSETTS
METR. DISTR. WATER SUPPLY COMMISSION
LOCATION OF REAL ESTATE ACQUIRED FOR THE WACHUSETT COLDBROOK TUNNEL

TOWNS	LENGTH OF TUNNEL (Feet)	TAKEN IN FEE (Acres)	EASEMENT FOR TUNNEL (Acres)	EASEMENT FOR POWER LINE (Acres)	EASEMENT FOR TUNNEL AND POWER LINE (Acres)	EASEMENT SURFACE R. of W. (Acres)	FEE & EASEMENT IN COMMONWEALTH (Acres)
West Boylston	4,290						
Holden	23,490	186.01	0.67	1.43	1.05	0.76	189.92
Rutland	33,460	92.76	0.45	6.32	0.62	1.53	101.68
Oakham	7,785	110.20	0.53	1.11	0.36		112.20
Barre	* 880	181.25			0.84		182.09
		**Measurements to Shaft 8 only.*					
Total	69,905	570.22	1.65	8.86	2.87	2.29	585.89

COMMONWEALTH OF MASSACHUSETTS
METR. DISTR. WATER SUPPLY COMMISSION

MONTHLY PROGRESS — REAL ESTATE ACQUIRED FOR THE SOUTHERN SUDBURY EMERGENCY SUPPLY

DATE	TAKING PLANS PREPARED	TAKEN IN FEE (Acres)	EASEMENT (Acres)	FEE & EASEMENTS IN COMMONWEALTH (Acres)	
December 1926					
January 1927					
February					
March					
April					
May	5				
June	3				
July	5	1.14	*14.09	15.23	*0.28 acres, easement for period of construction ending Jan. 1, 1928 only.
August					
September	1				
October		64.17	4.47	68.64	
November			10.74	10.74	
Total	14	65.31	29.30	94.61	

COMMONWEALTH OF MASSACHUSETTS
METR. DISTR. WATER SUPPLY COMMISSION

LOCATION OF REAL ESTATE ACQUIRED FOR THE SOUTHERN SUDBURY EMERGENCY SUPPLY

TOWNS	TAKEN IN FEE (Acres)	EASEMENT (Acres)	FEE & EASEMENT IN COMMONWEALTH (Acres)	
Southboro	1.14	9.60	10.74	
Ashland		*13.89	*13.89	*0.28 acres, easement for construction only until Jan. 1, 1928.
Hopkinton	64.17	4.47	68.64	
Framingham		1.34	1.34	
Total	65.31	29.30	94.61	

COMMONWEALTH OF MASSACHUSETTS
METR. DISTR. WATER SUPPLY COMMISSION

MONTHLY PROGRESS – REAL ESTATE ACQUIRED FOR THE SWIFT RIVER RESERVOIR

DATE	TOTAL APPLICATIONS LISTED (Acres)	LISTED BUT NOT REQUIRED (Acres)	PLACED UNDER OPTION (Acres)	TITLE VESTED IN COMMONWEALTH (Acres)	
December 1926	*1,629*	*174*	*586*	*16*	
January 1927	*1,704*	*/*	*876*	*1,007*	
February	*1,597*	*0*	*204*	*728*	
March	*4,441*	*57*	*1,103*	*493*	
April	*2,772*	*90*	*2,088*	*563*	
May	*2,373*	*217*	*1,591*	*513*	
June	*3,948*	*151*	*974*	*850*	
July	*1,747*	*174*	*1,647*	*1,337*	
August	*2,490*	*347*	*1,325*	*1,765*	
September	*3,847*	*502*	*1,675*	*2,045*	
October	*2,221*	*330*	*1,856*	*873*	
November	*825*	*240*	*1,444*	*700*	*Acreage is based upon estimates obtained from deeds or other information and not from surveys.*
Total for Year Ending Nov. 30, 1927	*29,594*	*2,283*	*15,369*	*10,890*	
Total to Nov. 30, 1926	*2,608*	*185*	*216*		
Total to Nov. 30, 1927	*32,202*	*2,468*	*15,585*	*10,890*	

COMMONWEALTH OF MASSACHUSETTS
METR. DISTR. WATER SUPPLY COMMISSION

LOCATION OF REAL ESTATE ACQUIRED FOR THE SWIFT RIVER RESERVOIR

TOWNS	TITLE VESTED IN COMMONWEALTH (Acres)
Belchertown	*230*
Dana	*920*
Enfield	*2,385*
Greenwich	*2418*
Hardwick	*12*
New Salem	*380*
Pelham	*770*
Petersham	*177*
Prescott	*3455*
Ware	*143*
Total	*10,890*

Acreage is based upon estimates obtained from deeds or other information and not from surveys.

COMMONWEALTH OF MASSACHUSETTS
METR. DISTR. WATER SUPPLY COMMISSION
STATUS OF CONTRACTS EXECUTED TO NOV. 30, 1927.

CONT. NO.	DESCRIPTION	LOCATION	CONTRACTOR	BIDS OPENED	CONTRACT AWARDED	AMOUNT OF CONTRACT	PAYMENTS TO DATE	FINAL ESTIMATE	DATE OF COMPLETION
1.	Borings	Tunnel line	Pennsylvania Drilling Co.	Nov. 5, 1926	Nov. 15, 1926	8,260.00		18,641.69	July 15, 1927
2.	Borings	Swift Dam Sites	Sprague & Henwood, Inc.	Nov. 5, 1926	Nov. 12, 1926	9,730.00		26,885.83	June 3, 1927
3.	Aerial Photographs	Swift Valley	Fairchild Aerial Surveys, Inc.		Nov. 22, 1926	5,600.00 Add. Material 1,355.00	397.50	5,600.00	Oct. 6, 1927
4.	Shaft 5	Rutland	James J. Coughlan & Sons, Inc.	Mar. 25, 1927	Mar. 28, 1927	137,854.80	92,423.16		
5.	Cordaville Pipe Line	Cordaville to Sudbury Res.	Lock Joint Pipe Co.	Apr. 15, 1927	Apr. 15, 1927	78,818.00	74,181.73		
6.	Cordaville Pumping Sta.	Cordaville	F. A. Mazzur Co., Inc.	Apr. 29, 1927	May 2, 1927	16,357.00	14,574.09		
7.	Hopkinton Pipe Line	Hopkinton Res. to Cordaville	Cenedella & Co.	Apr. 29, 1927	May 4, 1927	126,550.00	112,836.10		
8.	Shafts 6 & 7	Rutland	James J. Coughlan & Sons, Inc.	May 20, 1927	May 24, 1927	162,125.00	121,166.73		
9.	Aerial Photographs	Chicopee and Ware Rivers	Fairchild Aerial Surveys, Inc.		Mar. 30, 1927	2,500.00 Add. Material 590.00	22.50	2,500.00	May 7, 1927
10.	Transmission Line for Const. of Wachusett-Coldbrook Tunnel	Tunnel Line	New England Power Co.		Apr. 27, 1927	Construction at cost Maintenance at cost	2,167.01	86,439.58	Sept. 20, 1927
11.	Ashland Pipe Line	Ashland Res. to Reservoir No. 2	Antonio Mogarero	June 3, 1927	June 3, 1927	125,150.00	110,042.86		
12.	Shafts 2, 3 & 4	Holden and Rutland	Dravo Contracting Co.	May 20, 1927	May 24, 1927	259,800.00	181,163.16		
13.	Whitehall Pipe Line	Whitehall Res. to City Road	Portland Contracting Co.	July 15, 1927	July 15, 1927	54,963.00	43,130.46		
15.	Electric Power	Cordaville Pumping Sta.	Marlborough Electric Co.		Aug. 4, 1927				
16.	Whitehall Open Channel	City Road to Hopkinton Res.	Sanders Engineering Co.	Sept. 23, 1927	Sept. 23, 1927	36,720.00	6,239.07		

COMMONWEALTH OF MASSACHUSETTS
METR. DISTR. WATER SUPPLY COMMISSION
TOTAL VALUE OF WORK ESTIMATED UNDER CONTRACTS IN PROGRESS DURING YEAR ENDING NOV. 30, 1927.

CONTRACT NUMBER	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬	⑮	⑯
CONTRACTOR	PENNSYLVANIA DRILL. CO.	SPRAGUE & HENWOOD, INC	FAIRCHILD AERIAL SURVEYS, INC.	J. J. COUGHLAN & SONS, INC.	LOCKJOINT PIPE CO.	F. A. MAZZUR & CO. INC.	CENEDELLA & CO.	J. J. COUGHLAN & SONS, INC.	FAIRCHILD AERIAL SURVEYS INC.	NEW ENGLAND POWER CO.	ANTONIO MOGAVERO	DRAVO CONT. CO.	PORTLAND CONT. CO.	MARLBOROUGH ELECTRIC CO.	SANDERS ENG. CO.
AMOUNT OF CONTRACT.	8,260.00	9,730.00	* 5,600.00 1,355.00	137,854.80	78,818.00	16,357.00	126,550.00	162,125.00	* 2,500.00 590.00		125,150.00	259,800.00	54,963.00		56,720.00
DECEMBER 1926.	317.00														
JANUARY 1927	2,906.20	2,102.01	2,850.00												
FEBRUARY	4,440.40	4,531.39	2,850.00												
MARCH	7,781.55	9,359.50	2,850.00												
APRIL	10,879.85	18,321.29	2,850.00												
MAY	13,699.96	26,885.83	5,050.00	1,023.10					2,500.00						
JUNE	16,747.39	26,885.83	5,050.00	12,061.50	26,185.80	817.85	10,779.80			+ 40,740.00 293.11					
JULY	18,641.69		5,050.00	31,294.42	52,926.35	4,089.25	25,987.50	4,569.05	22.50	82,788.09 293.11	13,566.34	3,500.00			
AUGUST	SUPPLEMENTARY AGREEMENT.		5,050.00	38,513.03	65,913.20	12,267.75	82,127.25	21,867.78	22.50	82,788.09 293.11	36,652.03	31,432.35	3,882.03		
SEPTEMBER	1,891.45		5,050.00	53,459.32	71,410.80	14,230.59	105,735.06	48,975.05	22.50	86,439.58 841.00	86,165.12	81,302.90	24,660.57		
OCTOBER	4,890.45		5,600.00	78,622.45	77,824.30	15,539.15	118,657.10	96,099.13	22.50	1,409.80	109,118.39	143,863.10	36,862.75		
NOVEMBER 1927.	8,221.80		397.50	102,692.40	82,424.15	16,193.43	125,373.45	134,629.70	22.50	2,407.79	122,269.85	201,292.40	47,922.73		6,932.30

+ Top Figure is Construction Cost.
Lower Figure is Operation and Maintenance Cost.

* Upper Figure is Amount of Contract.
Lower Figure is for Additional Material.

Canvass of Bids for Contract 4 Opened March 25, 1927.

Commonwealth of Massachusetts Metr. Distr. Water Supply Commission Contract No. 4, Sinking Shaft No. 5 for Wachusett-Coldbrook Tunnel in the Town of Rutland. *Canvass of Bids opened Mar. 25, 1927.*				+ ① James J. Coughlan & Sons Inc. 27 School St. Boston, Mass.		② Dravo Contracting Co. Dravo Bldg. Pittsburg, Pa.		③ Bruno & Petitti. 18 Tremont St. Boston Mass.		④ Mason & Hanger Co. Inc. 52 Vanderbilt Ave. New York City.		⑤ Winston & Co. Inc. 240 Fair St. Kingston, N.Y.		⑥ Cenedella & Co. 68 School St. Milford, Mass.		⑦ Peter F. Connolly Co. 9 Jackson Ave. Long Island City, N.Y.		⑧ Simpson Bros. Corp. 77 Summer St. Boston, Mass.		⑨ Coleman Bros. Inc. 243 State St. Boston, Mass.		⑩ M. F. Gaddis. 38 Commonwealth Ave. Newton, Mass.		⑪ V. J. Grande. 100 Academy Hill Road. Boston, Mass.	
Item	Description	Unit	Quantity	Price	Amount	Price	Amount	Price	Amount	Price	Amount	Price	Amount	Price	Amount	Price	Amount	Price	Amount	Price	Amount	Price	Amount	Price	Amount
1.	*Earth Excavation.*	*Cu. Yds.*	*190.*	*6.50*	*1,235 00*	*13.50*	*2,565 00*	*10.00*	*1,900 00*	*19.50*	*3,705 00*	*20.00*	*3,800 00*	*30.00*	*5,700 00*	*20.00*	*3,800 00*	*20.00*	*3,800 00*	*10.00*	*1,900 00*	*100.00*	*19,000 00*	*100.00*	*19,000 00*
2.	*Rock Excavation, in Shaft and Tunnel.*	" "	*5780.*	*14.90*	*86,122 00*	*16.00*	*92,480 00*	*20.00*	*115,600 00*	*19.50*	*112,710 00*	*25.00*	*144,500 00*	*30.00*	*173,400 00*	*36.00*	*208,080 00*	*40.00*	*231,200 00*	*50.00*	*289,000 00*	*50.00*	*289,000 00*	*60.00*	*346,800 00*
3.	*Drainage, in Shaft and Tunnel.*	*Lin. Ft.*	*744.*	*22.20*	*16,516 80*	*13.50*	*10,044 00*	*2.00*	*1,488 00*	*1.00*	*744 00*	*2.00*	*1,488 00*	*10.00*	*7,440 00*	*10.00*	*7,440 00*	*21.00*	*15,624 00*	*10.00*	*7,440 00*	*10.00*	*7,440 00*	*20.00*	*14,880 00*
4.	*Forms, for Shaft Lining.*	" "	*632.*	*15.75*	*9,954 00*	*18.00*	*11,376 00*	*5.00*	*3,160 00*	*5.00*	*3160 00*	*9.00*	*5,688 00*	*10.00*	*6,320 00*	*10.00*	*6,320 00*	*30.00*	*18,960 00*	*13.00*	*8,216 00*	*20.00*	*12,640 00*	*20.00*	*12,640 00*
5.	*Concrete Shaft Lining.*	*Cu. Yds.*	*1540.*	*11.55*	*17,787 00*	*12.00*	*18,480 00*	*15.00*	*23,100 00*	*17.00*	*26180 00*	*13.00*	*20,020 00*	*15.00*	*23,100 00*	*17.00*	*26.180 00*	*14.00*	*21,560 00*	*25.00*	*38,500 00*	*10.00*	*15,400 00*	*30.00*	*46,200 00*
6.	*Portland Cement, for Concrete and Grout.*	*Bbls.*	*2400.*	*2.60*	*6,240 00*	*3.00*	*7,200 00*	*3.00*	*7,200 00*	*3.50*	*8400 00*	*3.00*	*7,200 00*	*4.00*	*9,600 00*	*4.00*	*9,600 00*	*3.50*	*8,400 00*	*3.00*	*7,200 00*	*5.00*	*12,000 00*	*4.00*	*9,600 00*
.			*Totals*		*137,854 80*		*142,145 00*		*152,448 00*		*154,899 00*		*182,696 00*		*225,560 00*		*261,420 00*		*299,544 00*		*352,256 00*		*355,480 00*		*449,120 00*

+ Contract awarded on Mar. 28, 1927 to James J. Coughlan & Sons Inc.

Canvass of Bids for Contract No. 5, opened Apr. 15, 1927.

COMMONWEALTH OF MASSACHUSETTS
Metr. Distr. Water Supply Commission
Contract 5. Constructing 30 Inch Pipe Line
From Cordaville to Sudbury Reservoir No. 5,
in the Town of Southborough.

				① R.C Lock Joint Pipe Co. P.O. Box, 21. Ampere, N.J.		* ② Cyl. Lock Joint Pipe Co. P.O. Box, 21. Ampere, N.J.		③ R.C. Cenedella & Co. 68 School St. Milford, Mass.		④ C.I. Cenedella & Co. 68 School St. Milford, Mass.		⑤ C.I. J.H. McCusker & Sons. 62 Church St. Waltham, Mass.		⑥ C.I. Winston & Co. Inc. 240 Fair St. Kingston, N.Y.		⑦ C.I. Louis Balboni. 419 Belgrade Ave. West Roxbury, Mass.		⑧ C.I. Vincenzio Barletta. 8 Whipple Ave. Roslindale, Mass.	
Item	Description	Unit	Quantity	Price	Amount	Price	Amount	Price	Amount	Price	Amount	Price	Amount	Price	Amount	Price	Amount	Price	Amount
1	Furnishing 30" * * pipe, and special castings.	Lin Ft.	8700.	6.00	52,200.00			6.70	58,290.00	7.10	61,770.00	8.27	71,949.00	9.30	80,910.00	8.00	69,600.00	7.40	64,380.00
2.	" 18" C.I " " " "	" "	220.	4.30	946.00	4.30	946.00	4.35	957.00	4.35	957.00	4.10	902.00	4.50	990.00	4.00	880.00	4.00	880.00
3.	" 12" C.I. " " " "	" "	240.	2.40	576.00	2.40	576.00	2.50	600.00	2.50	600.00	2.29	549.60	3.00	720.00	2.25	540.00	3.00	720.00
4.	" 24" C.I. or steel pipe and special castings	" "	50.	10.50	525.00	10.50	525.00	8.00	400.00	8.00	400.00	10.25	512.50	12.00	600.00	6.00	300.00	6.00	300.00
5.	Laying 30" pipe and special castings.	" "	8700.	.45	3915.00	.45	3915.00	1.60	13,920.00	1.60	13,920.00	.96	8,352.00	1.80	15,660.00	1.95	16,965.00	2.25	19,575.00
6.	Laying 18" C.I. pipe and special castings.	" "	220.	.70	154.00	.70	154.00	1.00	220.00	1.00	220.00	6.15	1,353.00	1.60	352.00	2.00	440.00	2.00	440.00
7.	" 12" C.I. " " " "	" "	220.	.60	132.00	.60	132.00	.80	176.00	.80	176.00	6.00	1,320.00	1.60	352.00	2.00	440.00	2.00	440.00
8.	" 24" C.I. " or steel pipe and castings, in Cordaville Mill.	Lump	sum.		1200.00		1200.00		350.00		350.00		700.00		1,000.00		1,000.00		800.00
9.	Earth excavation, fill and refill.	Cu.Yds.	9000.	1.25	11,250.00	1.25	11250.00	1.20	10,800.00	1.20	10,800.00	2.00	18,000.00	2.90	2,610.00	1.80	16,200.00	2.25	20,250.00
10.	Furnishing and placing valves, drains, well, gate boxes, etc.	Lump	sum.		700.00		700.00		750.00		750.00		765.00		2,500.00		1,000.00		400.00
11.	Concrete outlet well.	Lump	sum.		750.00		750.00		900.00		900.00		800.00		1,000.00		500.00		400.00
12.	Rock excavation and refill.	Cu.Yds.	250.	5.00	1250.00	5.00	1250.00	6.00	1500.00	6.00	1500.00	7.00	1750.00	6.00	1,500.00	10.00	2,500.00	8.00	2000.00
14.	Furnishing 30" reinforced concrete "Cylinder," Pipe. (Alternate for Item, 1.)	Lin Ft.	8700.			6.60	57,420.00												
		TOTALS			73,598.00		78,818.00		88,863.00		92,343.00		106,953.10		108,194.00		110,365.00		110,585.00

				⑨ C.I. Antonio Mogavero. 6 Dane St. Peabody, Mass.		⑩ C.I. V.N. Famiglietti & Sons, Inc. 166 Broadway, Providence, R.I.		⑪ C.I. Mark E. Kelley, Inc. 35 Foster St. Peabody, Mass.		⑫ C.I. Anthony Baruffaldi, Co. 52 Powderhouse Blvd. Somerville, Mass.		⑬ C.I. Bruno & Petitti. 18 Tremont St. Boston, Mass.		⑭ C.I. Middlesex Construction Co. 24 Union Ave. Framingham, Mass.		⑮ R.C. P.J. Keating, Co. 280 Main, St., Fitchburg, Mass.		⑯ C.I. V.J. Grande. 100 Academy Hill Rd. Boston, Mass.	
Item	Description	Unit	Quantity	Price	Amount	Price	Amount	Price	Amount	Price	Amount	Price	Amount	Price	Amount	Price	Amount	Price	Amount
1.	Furnishing 30" * * pipe, and special castings.	Lin.Ft.	8700.	8.05	70,035.00	9.50	82,650.00	9.66	84,042.00	8.25	71,775.00	8.25	71,775.00	8.50	73,950.00	8.15	70,905.00	10.00	87,000.00
2.	" 18" C.I. " " " "	- -	220.	3.85	847.00	5.00	1,100.00	4.86	1,069.20	4.50	990.00	5.00	1,100.00	8.50	1,870.00	10.50	2,310.00	6.50	1,430.00
3.	" 12" C.I. " " " "	- -	240.	2.25	540.00	3.00	720.00	2.00	480.00	3.00	720.00	3.00	720.00	4.50	1,080.00	4.50	1,080.00	4.00	960.00
4.	" 24" C.I. or steel pipe and special castings.	" "	50.	10.70	535.00	9.00	450.00	18.76	938.00	10.50	525.00	10.00	500.00	13.50	675.00	20.00	1,000.00	12.50	625.00
5.	Laying 30" pipe and special castings.	" "	8700.	1.57	13,659.00	1.50	13,050.00	1.82	15,834.00	1.50	13,050.00	2.00	174.00	2.50	21,750.00	1.90	16,530.00	2.50	21,750.00
6.	Laying 18" C.I. pipe and special castings.	" "	220.	75	165.00	.90	198.00	.69	151.80	1.00	220.00	1.00	220.00	1.50	330.00	1.90	418.00	2.50	550.00
7.	" 12" C.I. " " " "	- -	220.	.65	143.00	.60	132.00	.51	112.20	.50	110.00	1.00	220.00	1.50	330.00	1.90	418.00	2.00	440.00
8.	" 24" C.I. " or steel pipe and castings, in Cordaville Mill.	Lump	Sum.		865.00		375.00		877.00		500.00		400.00		2,000.00		1,000.00		5.00
9.	Earth excavation, fill and refill.	Cu.Yds.	9000.	2.45	22,050.00	1.80	16,200.00	1.60	14,400.00	3.50	31,500.00	3.00	27,000.00	2.50	22,500.00	3.90	35,100.00	2.50	22,500.00
10	Furnishing and placing valves, drains, well, gate boxes, etc.	Lump	Sum.		625.00		500.00		941.00		1,000.00		1,200.00		1,200.00		1,600.00		600.00
11	Concrete outlet well.	Lump.	Sum.		650.00		450.00		840.00		500.00		1,000.00		600.00		1,000.00		600.00
12.	Rock excavation and refill.	Cu. Yds.	250.	6.00	1500.00	6.00	1500.00	8.00	2,000.00	5.00	1,250.00	5.00	1,250.00	6.00	1,500.00	7.50	1,875.00	10.00	2500.00
14.	Furnishing 30" reinforced concrete, "Cylinder," Pipe (Alternate for Item, 1.)	Lin. Ft.	8700.																
		TOTALS			111,614.00		117,325.00		121,685.20		122,140.00		122,785.00		127,785.00		133,236.00		138,960.00

* Contract awarded on Apr. 15, 1927, to the Lock Joint Pipe Co.

* * Note:- C.I. = Cast Iron Pipe. R.C. = Reinforced Concrete Pipe. Cyl. = Reinforced Concrete Cylinder Pipe.

COMMONWEALTH OF MASSACHUSETTS
METR. DISTR. WATER SUPPLY COMMISSION

CONTRACT 6.

CONSTRUCTING A PUMPING STATION IN THE TOWN OF SOUTHBOROUGH.

CANVASS OF BIDS FOR CONTRACT 6, OPENED APRIL 29, 1927.

No.	NAME & ADDRESS OF BIDDER	AMOUNT.	REMARKS.
①	* F.A. Mazzur Co., Inc. 141 Milk St. Boston, Mass.	16,297 - 16,997.	Depending on the make of equipment to be furnished.
②	Hydraulic Development Co. 296 Boylston St. Boston, Mass.	16,379 - 16,824.	do
③	Joel E. Ballentine Co. 79 Sudbury St. Boston, Mass.	17,000.	
④	Starkweather & Broadhurst, Inc. 79 Milk St. Boston, Mass.	17,430.	
⑤	Guiney & Hanson Const. Co. 172 Milk St. Boston, Mass.	18,000	
⑥	M. J. Ahearn, Inc. 129 Washington St. Boston, Mass.	18,670 - 18,845.	Depending on the make of equipment to be furnished.
⑦	Rideout, Chandler & Joyce Inc. 172 High St. Boston, Mass.	19,320. - 20,350.	do.
⑧	Mark E. Kelly Co., Inc. 35 Foster St. Peabody, Mass.	19,893.	
⑨	V. J. Grande 100 Academy Hill Road Brighton, Mass.	28,000.	
⑩	Anthony Baruffaldi 52 Powder House Blvd. Somerville, Mass.	34,500.	

* Contract Awarded May 2, 1927 to F.A. Mazzur Co., Inc. for $16,357.00

CANVASS OF BIDS FOR CONTRACT NO. 7, OPENED APRIL 29, 1927.

COMMONWEALTH OF MASSACHUSETTS
METR. DISTR. WATER SUPPLY COMMISSION.
CONTRACT 7. CONSTRUCTING 30 INCH PIPE LINE
FROM HOPKINTON RESERVOIR TO CORDAVILLE
IN THE TOWNS OF ASHLAND AND SOUTHBOROUGH.

				* ① R.C. CENEDELLA & CO. 68 SCHOOL ST. MILFORD, MASS.		② C.I. MARK E. KELLY. CO. INC. 35 FOSTER ST. PEABODY, MASS.		③ R.C. LOCK JOINT PIPE CO. P.O. BOX, 21. AMPERE, N.J.		④ CYL. LOCK JOINT PIPE CO. P.O. BOX, 21. AMPERE, N.J.		⑤ C.I. CONNECTICUT CONCRETE, CO. 65 JEFFERSON ST. WATERBURY, CONN.		⑥ C.I. ANTHONY BARUFFALDI. 52 POWDERHOUSE BLVD. SOMERVILLE, MASS.	
ITEM	DESCRIPTION	UNIT	QUANTITY	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT
1.	Connection to 48" outlet pipe.	Lump	Sum		3,500.00		3,702.00		5,000.00		5,000.00		1,000.00		5,000.00
2.	Furnishing 30" diam. pipe, and special castings.†	Lin. Ft.	7000	6.00	42,000.00	9.69	67,830.00	6.60	46,200.00			12.00	84,000.00	8.00	56,000.00
3.	Laying 30" pipe and special castings.	" "	7000	3.00	21,000.00	1.82	12,740.00	2.50	17,500.00	2.50	17,500.00	2.90	20,300.00	5.00	35,000.00
4.	Excavation, fill and refill, from, 48" connection to Sta. 43+00.	Cu. Yds.	3500	4.90	17,150.00	4.15	14,525.00	10.00	35,000.00	10.00	35,000.00	3.00	10,500.00	5.00	17,500.00
5.	" " " " " 43+00 to connection at Cordoville.	" "	7000	2.85	19,950.00	3.35	23,450.00	4.00	28,000.00	4.00	28,000.00	3.00	21,000.00	5.00	35,000.00
6.	Sudbury River Crossing.	Lump	Sum		6,000.00		4,640.00		3,500.00		3,500.00		2,000.00		5,000.00
7.	Connection to 30" pipe line at Cordoville.	Lump	Sum		3,500.00		3,285.00		3,200.00		3,200.00		500.00		3,000.00
8.	Furnishing and placing paving.	Cu. Yds.	100	8.00	800.00	8.50	850.00	5.00	500.00	5.00	500.00	4.00	400.00	10.00	1,000.00
9.	" " " riprap.	" "	300	4.00	1,200.00	4.00	1,200.00	3.00	900.00	3.00	900.00	4.00	1,200.00	15.00	4,500.00
10.	" " " concrete.	" "	20	30.00	600.00	20.00	400.00	40.00	800.00	40.00	800.00	25.00	500.00	15.00	300.00
11.	Furnishing and placing 18" C.I. Culvert pipe.	Lin. Ft.	100	6.00	600.00	6.05	605.00	4.50	450.00	4.50	450.00	10.00	1,000.00	10.00	1,000.00
12.	" " constructing 6" blowoffs.		2	125.00	250.00	305.00	610.00	75.00	150.00	75.00	150.00	400.00	800.00	75.00	150.00
13.	" " " 4" " .		1	100.00	100.00	285.00	285.00	60.00	60.00	60.00	60.00	300.00	300.00	50.00	50.00
14.	" " " 2" air reliefs.		2	225.00	450.00	990.00	1,980.00	400.00	800.00	400.00	800.00	100.00	200.00	100.00	200.00
16.	" 30" Cylinder pipe & special castings. (Alternate for Item 2.)	Lin. Ft.	7000							6.60	46,200.00				
			TOTALS.		117,100.00		136,102.00		142,060.00		142,060.00		143,700.00		163,700.00

† NOTE:- C.I. = Cast Iron Pipe. R.C. = Reinforced Concrete Pipe. CYL. = Reinforced Concrete Cylinder Pipe.

* Contract awarded on May 4, 1927. to Cenedella & Co. on basis of cast iron pipe at \$7.35 per lin. ft. instead of reinforced concrete pipe for Item #2. TOTAL \$126,550.00

CANVASS OF BIDS FOR CONTRACT 8 OPENED MAY 20, 1927.

SHEET 1 OF 2

COMMONWEALTH OF MASSACHUSETTS
METR. DISTR. WATER SUPPLY COMMISSION
CONTRACT 8
SINKING SHAFT NO. 6 FOR WACHUSETT
COLDBROOK TUNNEL IN TOWN OF RUTLAND

				JAMES J. COUGHLAN & SONS, INC. 27 SCHOOL ST. BOSTON, MASS.		DRAVO CONT. CO. DRAVO BLDG. PITTSBURG, PA.		A. PHELPS & SONS 5150 BRADEN ST. DETROIT. MICH.		WINSTON & CO. INC. 240 FAIR ST. KINGSTON, N.Y.		ANTHONY BARUFFALDI 52 POWDER HOUSE BLVD SOMERVILLE, MASS.		BRUNO & PETITTI 18 TREMONT ST BOSTON, MASS.		V. J. GRANDE 100 ACADEMY HILL RD. BOSTON, MASS,	
				ALTERNATE A		ALTERNATE A		ALTERNATE A		ALTERNATE A		ALTERNATE A		ALTERNATE A		ALTERNATE A	
ITEM	DESCRIPTION	UNIT	QUANTITY	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT
1-6	Earth excavation to surface of rock.	Cu. Yds.	250	6.50	1625.00	10.00	2,500.00	30.00	7,500.00	20.00	5,000.00	10.00	2,500.00	20.00	5,000.00	50.00	12,500.00
2-6	Rock excavation in shaft and tunnel.	Cu. Yds.	3,900	13.65	53,235.00	13.50	52,650.00	20.00	78,000.00	20.00	78,000.00	20.00	78,000.00	25.00	97,500.00	32.00	124,800.00
3-6	Shaft and tunnel drainage.	Lin. Ft.	510	9.75	4,972.50	15.00	7,650.00	2.00	1020.00	10.00	5,100.00	15.00	7,650.00	10.00	5,100.00	15.00	7,650.00
4-6	Forms for concrete lining.	Lin. Ft.	400	15.75	6,300.00	21.50	8,600.00	13.00	5,200.00	10.00	4,000.00	10.00	4,000.00	10.00	4,000.00	15.00	6,000.00
5-6	Concrete lining.	Cu. Yds.	1,000	11.55	11,550.00	17.00	17,000.00	7.00	7,000.00	12.50	12,500.00	15.00	15,000.00	30.00	30,000.00	15.00	15,000.00
6-6	Portland cement.	Bbls.	1,600	2.70	4320.00	3.20	5,120.00	4.00	6,400.00	3.00	4,800.00	3.00	4,800.00	4.00	6,400.00	3.50	5,600.00
					82,002.50		93,520.00		105,120.00		109,400.00		111,950.00		148,000.00		174,550.00

				✡ JAMES J. COUGHLAN & SONS, INC. 27 SCHOOL ST. BOSTON, MASS.		DRAVO CONT. CO. DRAVO BLDG. PITTSBURG, PA.		WINSTON & CO. INC. 240 FAIR ST. KINGSTON, N.Y.		JAMES J. COUGHLAN & SONS, INC. 27 SCHOOL ST. BOSTON, MASS.		DRAVO CONT. CO. DRAVO. BLDG. PITTSBURG, PA.		WINSTON & CO. INC. 240 FAIR ST. KINGSTON, N.Y.		M. F. GADDIS 6 BEACON ST. BOSTON, MASS.	
				ALTERNATE B		ALTERNATE B		ALTERNATE B		ALTERNATE C		ALTERNATE C		ALTERNATE C		ALTERNATE C	
ITEM	DESCRIPTION	UNIT	QUANTITY	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT
1-6	Earth excavation to surface of rock.	Cu. Yds.	250	6.50	1,625.00	10.00	2,500.00	21.00	5,250.00	6.50	1,625.00	10.00	2,500.00	19.00	4,750.00	20.00	5,000.00
2-6	Rock excavation in shaft and tunnel.	Cu. Yds.	3,900	13.65	53,235.00	13.00	50,700.00	21.00	81,900.00	13.65	53,235.00	12.50	48,750.00	19.00	74,100.00	21.00	81,900.00
3-6	Shaft and tunnel drainage.	Lin. Ft.	510	9.75	4,972.50	15.00	7,650.00	10.00	5,100.00	9.75	4,972.50	15.00	7,650.00	10.00	5,100.00	5.00	2,550.00
4-6	Forms for concrete lining.	Lin. Ft.	400	15.75	6,300.00	21.50	8,600.00	10.00	4,000.00	15.75	6,300.00	21.50	8,600.00	10.00	4,000.00	3.00	1,200.00
5-6	Concrete lining.	Cu. Yds.	1,000	11.55	11,550.00	17.00	17,000.00	12.50	12,500.00	11.55	11,550.00	17.00	17,000.00	12.50	12,500.00	10.50	10,500.00
6-6	Portland cement	Bbls.	1,600	2.70	4,320.00	3.20	5,120.00	3.00	4,800.00	2.70	4,320.00	3.20	5,120.00	3.00	4,800.00	4.00	6,400.00
					82,002.50		91,570.00		113,550.00		82,002.50		89,620.00		105,250.00		107,550.00

✡ Contract awarded to James J. Coughlan & Sons Inc. May 24, 1927.

CANVASS OF BIDS FOR CONTRACT 8 OPENED MAY 20, 1927.

SHEET 2 OF 2

COMMONWEALTH OF MASSACHUSETTS
METR. DISTR. WATER SUPPLY COMMISSION
CONTRACT 8
SINKING SHAFT NO. 7 FOR WACHUSETT
COLDBROOK TUNNEL IN TOWN OF RUTLAND

				DRAVO CONT. CO. DRAVO BLDG. PITTSBURG, PA.		A. PHELPS & SONS 5150 BRADEN ST. DETROIT, MICH.		WINSTON & CO. INC. 240 FAIR ST. KINGSTON, N.Y		ANTHONY BARUFFALDI 52 POWDER HOUSE BLVD SOMERVILLE, MASS.		BRUNO & PETITTI 18 TREMONT ST. BOSTON, MASS.		V.J. GRANDE 100 ACADEMY HILL RD BOSTON, MASS.			
				ALTERNATE A		ALTERNATE A		ALTERNATE A		ALTERNATE A		ALTERNATE A		ALTERNATE A		ALTERNATE A	
ITEM	DESCRIPTION	UNIT	QUANTITY	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT
1-7	Earth excavation to surface of rock.	Cu. Yds.	175	10.00	1,750.00	30.00	5,250.00	20.00	3,500.00	10.00	1,750.00	30.00	5,250.00	50.00	8,750.00		
2-7	Rock excavation in shaft and Tunnel.	Cu. Yds.	3800	13.50	51,300.00	20.00	76,000.00	20.00	76,000.00	20.00	76,000.00	30.00	114,000.00	34.00	129,200.00		
3-7	Shaft and tunnel drainage.	Lin. Ft.	490	15.00	7,350.00	2.00	980.00	10.00	4,900.00	15.00	7,350.00	10.00	4,900.00	15.00	7,350.00		
4-7	Forms for concrete lining.	Lin. Ft.	380	21.50	8,170.00	13.00	4,940.00	10.00	3,800.00	10.00	3,800.00	10.00	3,800.00	15.00	5,700.00		
5-7	Concrete lining.	Cu. Yds.	950	17.00	16,150.00	7.00	6,650.00	12.50	11,875.00	15.00	14,250.00	30.00	28,500.00	15.00	14,250.00		
6-7	Portland cement.	Bbls.	1,500	3.20	4,800.00	4.00	6,000.00	3.00	4,500.00	3.00	4,500.00	4.00	6,000.00	3.50	5,250.00		
					89,520.00		99,820.00		104,575.00		107,650.00		162,450.00		170,500.00		

				★ JAMES J. COUGHLAN & SONS, INC. 27 SCHOOL ST. BOSTON, MASS.		DRAVO CONT. CO. DRAVO BLDG. PITTSBURG, PA.		WINSTON & CO. INC. 240 FAIR ST. KINGSTON N.Y.		JAMES J. COUGHLAN & SONS, INC. 27 SCHOOL ST. BOSTON, MASS.		DRAVO CONT. CO. DRAVO BLDG. PITTSBURG, PA.		WINSTON & CO. INC. 240 FAIR ST. KINGSTON, N.Y.		M. F. GADDIS 6 BEACON ST. BOSTON MASS.	
				ALTERNATE B		ALTERNATE B		ALTERNATE B		ALTERNATE C		ALTERNATE C		ALTERNATE C		ALTERNATE C	
ITEM	DESCRIPTION	UNIT	QUANTITY	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT
1-7	Earth excavation to surface of rock.	Cu. Yds.	175	6.50	1,137.50	10.00	1,750.00	21.00	3,675.00	6.50	1,137.50	10.00	1,750.00	19.00	3,325.00	20.00	3,500.00
2-7	Rock excavation in shaft and tunnel.	Cu. Yds.	3800	14.00	53,200.00	13.00	49,400.00	21.00	79,800.00	14.00	53,200.00	12.50	47,500.00	19.00	72,200.00	21.00	79,800.00
3-7	Shaft and Tunnel drainage	Lin. Ft.	490	9.75	4,777.50	15.00	7,350.00	10.00	4,900.00	9.75	4,777.50	15.00	7,350.00	10.00	4,900.00	5.00	2,450.00
4-7	Forms for concrete lining	Lin. Ft.	380	15.75	5,985.00	21.50	8,170.00	10.00	3,800.00	15.75	5,985.00	21.50	8,170.00	10.00	3,800.00	3.00	1,140.00
5-7	Concrete lining.	Cu. Yds.	950	11.55	10,972.50	17.00	16,150.00	12.50	11,875.00	11.55	10,972.50	17.00	16,150.00	12.50	11,875.00	10.50	9,975.00
6-7	Portland cememt.	Bbls.	1,500	2.70	4,050.00	3.20	4,800.00	3.00	4,500.00	2.70	4,050.00	3.20	4,800.00	3.00	4,500.00	4.00	6,000.00
					80,122.50		87,620.00		108,550.00		80,122.50		85,720.00		100,600.00		102,865.00

★ Contract awarded to James J. Coughlan & Sons Inc. May 24, 1927.

*CANVASS OF BIDS FOR CONTRACTS 8 AND 12†

CONTRACTORS BIDDING ON	SHAFT 2	SHAFT 3	SHAFT 4	SHAFT 6	SHAFT 7
*JAMES J. COUGHLAN & SONS, INC. BOSTON, MASS.	72,958.80 ⑤	89,851.90 ⑤	90,085.00 ①	82,002.50 ①	80,122.50 ② of #4, #6, #7 only
**DRAVO CONTRACTING CO. PITTSBURG, PA.	70,310.00 ⑤	86,250.00 ⑤	98,190.00 ⑤	89,620.00 ⑤	85,720.00 ⑤
" " " " "	71,810.00 ③	87,700.00 ③	100,290.00 ③	91,570.00 ③	87,620.00 ③
" " " " "	73,310.00 ①	89,150.00 ①	102,390.00 ①	93,520.00 ①	89,520.00 ①
A. PHELPS & SONS, DETROIT, MICH.	82,610.00 ①	125,115.00 ①	107,590.00 ①	105,120.00 ①	99,820.00 ①
WINSTON & CO., INC., KINGSTON, N.Y.	81,825.00 ③	94,800.00 ③	115,625.00 ③	113,550.00 ③	108,550.00 ③
" " " " "	81,825.00 ⑤	94,800.00 ⑤	115,625.00 ⑤	105,250.00 ⑤	100,600.00 ⑤
" " " " "	85,100.00 ①	101,950.00 ①	120,050.00 ①	109,400.00 ①	104,575.00 ①
M.F. GADDIS, BOSTON, MASS.	85,400.00 ⑤	97,765.00 ⑤	119,320.00 ⑤	107,550.00 ⑤	102,865.00 ⑤
ANTHONY BARUFFALDI, SOMERVILLE, MASS.	105,250.00 ①	146,100.00 ①	121,650.00 ①	111,950.00 ①	107,650.00 ①
BRUNO & PETITTI, BOSTON, MASS.	111,000.00 ①	151,750.00 ①	161,500.00 ①	148,000.00 ①	162,450.00 ①
V. J. GRANDE, BOSTON, MASS.	174,430.00 ①	275,350.00 ①	252,100.00 ①	171,550.00 ①	170,500.00 ①
G. R. LAVALLEE, WORCESTER, MASS.	Informal bid only.				

The number in the circle opposite each price bid indicates the least total number of shafts which must be included in the contract and means that this price applies to this shaft, only in case a contract is awarded to this bidder for at least this total number of shafts and at the prices for the other shafts shown in the same horizontal line.

†Advertised as Contract 8

ELEVEN LOW BID COMBINATIONS

COUGHLAN,	SHAFTS,	4-6-7.	DRAVO-	SHAFTS	2-3	= 414,670.00
"	"	2-3-4-6-7				= 415,020.70
"	"	4-6	DRAVO,	SHAFTS	2-3-7	= 419,217.50
"	"	4-7	"	"	2-3-6	= 421,287.50
* "	"	6-7**	"	"	2-3-4	= 421,925.00
"	"	4-6-7	"	"	3. PHELPS SHAFT 2	= 423,970.00
"	"	4-6-7	"	"	3. WINSTON " 2	= 426,460.00
"	"	4-6-7	"	"	2 " " 3	= 427,470.00
"	"	4	"	"	2-3-6-7	= 428,785.00
"	"	6	"	"	2-3-4-7	= 429,422.50
DRAVO	"	2-3-4-6-7				= 430,090.00

*Contract 8 awarded to Coughlan for Shafts 6 & 7 for $162,125.00 } May 24, 1927.
** " 12 " " Dravo " " 2, 3 & 4 $259,800.00 }

COMMONWEALTH OF MASSACHUSETTS
METR. DISTR. WATER SUPPLY COMMISSION
CONTRACTS 8 & 12†
SINKING SHAFTS NO. 2, 3, 4, 6, & 7 FOR WACHUSETT-COLDBROOK TUNNEL IN TOWNS OF RUTLAND AND HOLDEN

CANVASS OF BIDS FOR CONTRACT 11 OPENED JUNE 3, 1927.

COMMONWEALTH OF MASSACHUSETTS
METR. DISTR. WATER SUPPLY COMMISSION

CONTRACT NO. 11 CONSTRUCTING 24" PIPE LINE FROM ASHLAND RESERVOIR TO GATE HOUSE AT FRAMINGHAM RESERVOIR NO. 2 IN THE TOWNS OF ASHLAND AND FRAMINGHAM.

				* ① ANTONIO MOGAVERO 6 Dane St. Peabody, Mass.		② LOCK JOINT PIPE CO. Ampere, N.J.		③ MARK E. KELLEY CO. INC. 33 Foster St. Peabody, Mass.		④ CENEDELLA & CO. 68 School St. Milford, Mass.		⑤ GENERAL CONTRACTING CO. INC. 32 Beach Ave. Salem, Mass.		⑥ ANTHONY GARUFFALDI 32 Powder House Blvd. Somerville, Mass.		⑦ TAYLOR CONSTRUCTION CO. 42 Main St Milford, Mass.		⑧ JOHN H. McCUSKER 62 Church St. Waltham, Mass.		⑨ VINCENZO BARLETTA 8 Whipple Ave. Roslindale, Mass.		⑩ WINSTON & CO. INC. 240 Fair St. Kingston, N.Y.		⑪ LOUIS BALBONI 419 Belgrade Ave. West Roxbury, Mass.		⑫ V. J. GRANDE 100 Academy Hill Rd. Boston, Mass.	
ITEM	DESCRIPTION	UNIT	QUANTITY	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT
1	Connection to 48" outlet pipe of Ashland Reservoir.	Lump	Sum		1800.00		1800.00		2170.00		2300.00		1450.00		1500.00		400.00		2304.00		3000.00		2000.00		1000.00		4500.00
	Furnishing 24" Cast Iron Pipe or	Lin. Ft.	13,500	5.30	71,550.00			6.23	84,105.00	5.70	76,950.00	4.93	66,555.00	5.00	67,500.00	6.00	81,000.00	7.02	94,770.00	5.00	67,500.00	6.50	87,750.00	6.00	81,000.00	5.75	77,625.00
2	Furnishing 24" reinforced concrete "cylinder" pipe.	Lin. Ft.	13,500			6.00	81,000.00																				
3	Furnishing 20" cast iron pipe and special castings.	Lin. Ft.	1000	4.30	4300.00	5.50	5,500.00	5.26	5260.00	5.00	5000.00	3.70	3700.00	4.00	4000.00	5.00	5000.00	5.60	5600.00	3.81	3810.00	6.00	6000.00	5.50	5,500.00	5.00	5000.00
4	Laying 24" pipe and special castings.	Lin. Ft.	13,500	0.65	8,775.00	0.50	6,750.00	0.79	10,665.00	1.15	15,525.00	1.50	20,250.00	2.00	27,000.00	0.80	10,800.00	0.59	7965.00	2.15	29,025.00	1.50	20,250.00	2.50	33,750.00	4.00	54,000.00
5	Laying 20" cast iron pipe and special castings.	Lin. Ft.	1,000	0.65	650.00	1.30	1300.00	0.65	650.00	1.55	1550.00	1.40	1,400.00	2.00	2000.00	0.70	700.00	0.54	540.00	3.00	3000.00	2.00	2000.00	10.00	10,000.00	5.00	5000.00
6	Earth excavation, fill and refill.	Cu. Yds	12,500	1.49	18,625.00	1.40	17,500.00	1.60	20,000.00	1.46	18,250.00	2.40	30,000.00	2.00	25,000.00	2.50	31,250.00	1.25	15,625.00	2.20	27,500.00	3.00	37,500.00	2.00	25,000.00	2.00	25,000.00
7	Rock excavation and refill.	Cu Yds.	100	5.00	500.00	4.00	400.00	7.00	700.00	8.00	800.00	12.00	1200.00	5.00	500.00	10.00	1,000.00	7.00	700.00	7.00	700.00	7.00	700.00	8.00	800.00	8.00	800.00
8	Upper crossing of Framingham Reservoir No. 2.	Lump	Sum		900.00		4000.00		1,750.00		2000.00		1,000.00		2000.00		4,000.00		1520.00		1500.00		1,000.00		1000.00		2,500.00
9	Crossing of Boston & Albany Railroad.	Lump	Sum		3500.00		6,000.00		768.00		3,300.00		3000.00		3000.00		1,000.00		4,000.00		3,000.00		2,000.00		5,000.00		3,500.00
10.	Connection to Gate House and lower crossing of Reservoir.	Lump	Sum		11,000.00		7,000.00		6,349.00		8,000.00		5,500.00		5000.00		5,000.00		6,350.00		8000.00		10,000.00		5,000.00		6,000.00
11.	Furnishing and placing paving.	Cu. Yds.	10	10.00	100.00	10.00	100.00	8.00	80.00	10.00	100.00	15.00	150.00	10.00	100.00	8.00	80.00	20.00	200.00	10.00	100.00	10.00	100.00	10.00	100.00	10.00	100.00
12	Furnishing and placing riprap	Cu. Yds.	75	8.00	600.00	4.00	300.00	4.00	300.00	4.00	300.00	12.00	900.00	4.00	300.00	4.50	337.50	12.00	900.00	10.00	750.00	5.00	375.00	10.00	750.00	7.00	525.00
13	Furnishing and placing concrete.	Cu. Yds.	50	20.00	1,000.00	30.00	1,500.00	20.00	1000.00	20.00	1,000.00	25.00	1,250.00	10.00	500.00	30.00	1500.00	25.00	1,250.00	25.00	1250.00	30.00	1500.00	30.00	1500.00	12.00	600.00
14	Furnishing and placing 18" cast iron culvert pipe.	Lin. Ft	120	7.50	900.00	5.50	660.00	6.05	726.00	5.00	600.00	7.00	840.00	7.00	840.00	6.00	720.00	4.50	540.00	7.00	840.00	5.00	600.00	10.00	1200.00	5.00	600.00
15	Furnishing and constructing 6" blow-offs.		3	150.00	450.00	200.00	600.00	200.00	600.00	125.00	375.00	150.00	450.00	75.00	225.00	25.00	75.00	168.00	504.00	150.00	450.00	100.00	300.00	50.00	150.00	100.00	300.00
16.	Furnishing and constructing 4" blow-offs.		2	150.00	300.00	100.00	200.00	175.00	350.00	100.00	200.00	125.00	250.00	75.00	150.00	25.00	50.00	53.00	106.00	125.00	250.00	100.00	200.00	50.00	100.00	50.00	100.00
17.	Furnishing and constructing 2" air-reliefs.		1	100.00	100.00	100.00	100.00	150.00	150.00	200.00	200.00	75.00	75.00	150.00	150.00	50.00	50.00	40.50	40.50	75.00	75.00	50.00	50.00	50.00	50.00	25.00	25.00
18.	Installing 20"x10" Venturi meter and appurtenances.	Lump	Sum	100.00	100.00		300.00		460.00		600.00		350.00		500.00		200.00		260.00		300.00		200.00		1000.00		1800.00
*	Contract awarded to Antonio Mogavero. June 3, 1927.				125,150.00		135,010.00		136,083.00		137,550.00		138,320.00		140,265.00		143,162.50		143,174.50		151,050.00		172,525.00		172,900.00		186,035.00

CANVASS OF BIDS FOR CONTRACT 12† OPENED MAY 20, 1927.

SHEET 1 OF 3

COMMONWEALTH OF MASSACHUSETTS
METR. DISTR. WATER SUPPLY COMMISSION
CONTRACT 12†
SINKING SHAFT NO. 2 FOR WACHUSETT
COLDBROOK TUNNEL IN TOWN OF HOLDEN

				DRAVO CONT. CO. DRAVO BLDG. PITTSBURG, PA.		A. PHELPS & SONS 5150 BRADEN ST. DETROIT, MICH.		WINSTON & CO. INC. 240 FAIR ST. KINGSTON, N.Y.		ANTHONY BARUFFALDI 52 POWDER HO. BLVD. SOMERVILLE, MASS.		BRUNO & PETITTI 18 TREMONT ST. BOSTON, MASS.		* G.R. LAVALLEE 20 CLEMENT ST. WORCESTER, MASS.		V. J. GRANDE 100 ACADEMEY HILL RD. BOSTON, MASS.	
				ALTERNATE A		ALTERNATE A		ALTERNATE A		ALTERNATE A		ALTERNATE A		ALTERNATE A		ALTERNATE A	
ITEM	DESCRIPTION	UNIT	QUANTITY	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT
1-2	Earth excavation to surface of rock	Cu. Yds.	275	10.00	2750.00	30.00	8250.00	20.00	5500.00	10.00	2750.00	20.00	5500.00	3.00	825.00	60.00	16,500.00
2-2	Rock excavation in shaft and tunnel	Cu. Yds.	3000	14.00	42,000.00	20.00	60,000.00	20.00	60,000.00	27.00	81,000.00	25.00	75,000.00	30.00	90,000.00	42.00	126,000.00
3-2	Shaft and tunnel drainage	Lin. Ft.	400	15.00	6000.00	2.00	800.00	10.00	4000.00	15.00	6,000.00	10.00	4,000.00	4.50	1800.00	25.00	10,000.00
4-2	Forms for concrete lining	Lin. Ft.	240	22.00	5,280.00	14.00	3,360.00	10.00	2400.00	10.00	2,400.00	10.00	2400.00	50.00	12,000.00	22.00	5,280.00
5-2	Concrete lining	Cu. Yds.	600	16.00	9600.00	7.00	4,200.00	12.50	7,500.00	15.00	9,000.00	30.00	18,000.00	17.50	10,500.00	15.00	9,000.00
6-2	Portland cement	Bbls.	900	3.20	2880.00	4.00	3,600.00	3.00	2,700.00	3.00	2,700.00	4.00	3,600.00	3.00	2,700.00	3.50	3,150.00
7-2	Liquid chlorine	Lbs.	2000	15¢	300.00	20¢	400.00	25¢	500.00	20¢	400.00	25¢	500.00	15%	above cost	1.50	3,000.00
8-2	Chlorine dosing machine		1	4500	4,500.00	2000	2000.00	2500	2500.00	1,000	1,000.00	2000	2000.00	20%	" "	1500	1,500.00
					73,310.00		82,610.00		85,100.00		105,250.00		111,000.00		Items 2-5 Only Subtotal 117,825.00		174,430.00

				✡ DRAVO CONT. CO. DRAVO BLDG. PITTSBURG, PA.		WINSTON & CO. INC. 240 FAIR ST. KINGSTON, N.Y.		DRAVO CONT. CO. DRAVO BLDG. PITTSBURG, PA.		JAMES J. COUGHLAN & SONS, INC. 27 SCHOOL ST. BOSTON, MASS.		WINSTON & CO. INC. 240 FAIR ST. KINGSTON, N.Y.		M.F. GADDIS 6 BEACON ST. BOSTON, MASS.	
				ALTERNATE B		ALTERNATE B		ALTERNATE C		ALTERNATE C		ALTERNATE C		ALTERNATE C	
ITEM	DESCRIPTION	UNIT	QUANTITY	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT
1-2	Earth excavation to surface of rock	Cu. Yds.	275	10.00	2750.00	19.00	5225.00	10.00	2750.00	10.00	2,750.00	19.00	5225.00	20.00	5,500.00
2-2	Rock excavation in shaft and tunnel	Cu. Yds.	3000	13.50	40,500.00	19.00	57,000.00	13.00	39,000.00	14.90	44,700.00	19.00	57,000.00	21.00	63,000.00
3-2	Shaft and tunnel drainage	Lin. Ft.	400	15.00	6000.00	10.00	4,000.00	15.00	6000.00	22.20	8880.00	10.00	4,000.00	5.00	2000.00
4-2	Forms for concrete lining	Lin. Ft.	240	22.00	5280.00	10.00	2,400.00	22.00	5,280.00	18.62	4,468.80	10.00	2,400.00	3.00	720.00
5-2	Concrete lining	Cu. Yds.	600	16.00	9,600.00	12.50	7,500.00	16.00	9,600.00	11.55	6,930.00	12.50	7,500.00	10.50	6,300.00
6-2	Portland cement	Bbls.	900	3.20	2880.00	3.00	2,700.00	3.20	2880.00	2.70	2,430.00	3.00	2,700.00	4.00	3,600.00
7-2	Liquid chlorine	Lbs.	2000	15¢	300.00	25¢	500.00	15¢	300.00	15¢	300.00	25¢	500.00	14¢	280.00
8-2	Chlorine dosing machine		1	4500	4500.00	2500	2500.00	4500	4500.00	2500	2500.00	2500	2,500.00	4000	4000.00
					71,810.00		81,825.00		70,310.00		72,958.80		81,825.00		85,400.00

†Advertised as Contract 8

*Informal bid.

✡Contract awarded to Dravo Cont. Co. May 24, 1927.

CANVASS OF BIDS FOR CONTRACT 12† OPENED MAY 20, 1927.

SHEET 2 OF 3

COMMONWEALTH OF MASSACHUSETTS
METR. DISTR. WATER SUPPLY COMMISSION

CONTRACT 12†

SINKING SHAFT NO. 3 FOR WACHUSETT
COLDBROOK TUNNEL IN TOWN OF HOLDEN

				DRAVO CONT. CO. DRAVO BLDG. PITTSBURG, PA.		WINSTON & CO. INC. 240 FAIR ST. KINGSTON, N.Y.		A. PHELPS & SONS 5150 BRADEN ST. DETROIT, MICH.		ANTHONY BARUFFALDI 52 POWDER HO BLVD SOMERVILLE, MASS.		BRUNO & PETITTI 18 TREMONT ST. BOSTON, MASS.		V. J. GRANDE 100 ACADEMEY HILL RD BOSTON, MASS.	
				ALTERNATE A		ALTERNATE A		ALTERNATE A		ALTERNATE A		ALTERNATE A		ALTERNATE A	
ITEM	DESCRIPTION	UNIT	QUANTITY	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT
1-3	Earth excavation to surface of rock.	Cu. Yds.	675	10.00	6,750.00	21.00	14,175.00	45.00	30,375.00	30.00	20,250.00	30.00	20,250.00	100.00	67,500.00
2-3	Rock excavation in shaft and tunnel.	Cu. Yds.	2900	14.00	40,600.00	21.00	60,900.00	24.00	69,600.00	30.00	87,000.00	30.00	87,000.00	52.00	150,800.00
3-3	Shaft and tunnel drainage.	Lin. Ft.	430	15.00	6,450.00	10.00	4,300.00	2.00	860.00	25.00	10,750.00	10.00	4,300.00	25.00	10,750.00
4-3	Forms for concrete lining.	Lin. Ft.	320	30.00	9,600.00	10.00	3,200.00	14.00	4,480.00	10.00	3,200.00	10.00	3,200.00	40.00	12,800.00
5-3	Concrete lining.	Cu. Yds.	950	17.00	16,150.00	12.50	11,875.00	12.00	11,400.00	20.00	19,000.00	30.00	28,500.00	25.00	23,750.00
6-3	Portland cement.	Bbls.	1,500	3.20	4,800.00	3.00	4,500.00	4.00	6,000.00	3.00	4,500.00	4.00	6,000.00	3.50	5,250.00
7-3	Liquid chlorine.	Lbs.	2,000	15¢	300.00	25¢	500.00	20¢	400.00	20¢	400.00	25¢	500.00	1.50	3,000.00
8-3	Chlorine dosing machine.		1	4,500	4,500.00	2,500	2,500.00	2,000	2,000.00	1,000	1,000.00	2,000	2,000.00	6,500	6,500.00
					89,150.00		101,950.00		125,115.00		146,100.00		151,750.00		275,350.00

				★ DRAVO CONT. CO. DRAVO BLDG. PITTSBURG, PA.		WINSTON & CO. INC. 240 FAIR ST. KINGSTON, N.Y.		DRAVO CONT. CO. DRAVO BLDG. PITTSBURG, PA.		JAMES J. COUGHLAN & SONS, INC. 27 SCHOOL ST. BOSTON, MASS.		WINSTON & CO. INC. 240 FAIR ST. BOSTON, MASS.		M. F. GADDIS 6 BEACON ST. BOSTON, MASS.	
				ALTERNATE B		ALTERNATE B		ALTERNATE C		ALTERNATE C		ALTERNATE C		ALTERNATE C	
ITEM	DESCRIPTION	UNIT	QUANTITY	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT
1-3	Earth excavation to surface of rock	Cu. Yds.	675	10.00	6750.00	19.00	12,825.00	10.00	6750.00	15.00	10,125.00	19.00	12,875.00	20.00	13,500.00
2-3	Rock excavation in shaft and tunnel	Cu. Yds.	2900	13.50	37,150.00	19.00	55,100.00	13.00	37,700.00	16.00	46,400.00	19.00	55,100.00	21.00	60,900.00
3-3	Shaft and tunnel drainage	Lin. Ft.	430	15.00	6450.00	10.00	4300.00	15.00	6450.00	22.20	9,546.00	10.00	4,300.00	5.00	2,150.00
4-3	Forms for concrete lining	Lin. Ft.	320	30.00	9600.00	10.00	3200.00	30.00	9600.00	18.62	5,958.40	10.00	3200.00	3.00	960.00
5-3	Concrete lining	Cu. Yds.	950	17.00	16,150.00	12.50	11,875.00	17.00	16,150.00	11.55	10,972.50	12.50	11,875.00	10.50	9,975.00
6-3	Portland cement	Bbls.	1500	3.20	4800.00	3.00	4,500.00	3.20	4800.00	2.70	4,050.00	3.00	4,500.00	4.00	6,000.00
7-3	Liquid chlorine	Lbs.	2000	15¢	300.00	25¢	500.00	15¢	300.00	15¢	300.00	25¢	500.00	14¢	280.00
8-3	Chlorine dosing machine		1	4500	4500.00	2500	2500.00	4500	4500.00	2500	2500.00	2500	2500.00	4000	4000.00
					87,700.00		94,800.00		86,250.00		89,851.90		94,800.00		97,765.00

†Advertised as Contract 8

★Contract awarded to Dravo Cont. Co. May 24, 1927.

CANVASS OF BIDS FOR CONTRACT 12† OPENED MAY 20, 1927.

SHEET 3 OF 3

COMMONWEALTH OF MASSACHUSETTS
METR. DISTR. WATER SUPPLY COMMISSION
CONTRACT 12†
SINKING SHAFT NO. 4 FOR WACHUSETT
COLDBROOK TUNNEL IN TOWN OF RUTLAND

				JAMES J. COUGHLAN & SONS, INC. 27 SCHOOL ST. BOSTON, MASS.		DRAVO CONT. CO. DRAVO BLDG. PITTSBURG, PA.		A. PHELPS & SONS 5130 BRADEN ST. DETROIT, MICH.		WINSTON & CO. INC. 240 FAIR ST. KINGSTON, N.Y.		ANTHONY BARUFFALDI 52 POWDER HO. BLVD. SOMERVILLE, MASS.		BRUNO & PETITTI 18 TREMONT ST. BOSTON, MASS.		V. J. GRANDE 100 ACADEMEY HILL RD. BOSTON, MASS.	
				ALTERNATE A		ALTERNATE A		ALTERNATE A		ALTERNATE A		ALTERNATE A		ALTERNATE A		ALTERNATE A	
ITEM	DESCRIPTION	UNIT	QUANTITY	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT
1-4	Earth excavation to surface of rock	Cu. Yds.	225	6.50	1,462.50	10.00	2,250.00	30.00	6,750.00	20.00	4,500.00	10.00	2,250.00	20.00	4,500.00	50.00	11,250.00
2-4	Rock excavation in shaft and tunnel	Cu. Yds.	4,200	13.45	56,490.00	13.50	56,700.00	18.50	77,700.00	20.00	84,000.00	20.00	84,000.00	25.00	105,000.00	45.00	189,000.00
3-4	Shaft and tunnel drainage	Lin. Ft.	540	9.75	5,265.00	15.00	8,100.00	2.00	1,080.00	10.00	5,400.00	15.00	8,100.00	10.00	5400.00	20.00	10,800.00
4-4	Forms for concrete lining	Lin. Ft.	430	15.75	6,772.50	20.00	8600.00	12.00	5,160.00	10.00	4,300.00	10.00	4,300.00	10.00	4300.00	20.00	8600.00
5-4	Concrete lining	Cu. Yds.	1,100	11.55	12,705.00	15.00	16,500.00	7.00	7,700.00	12.50	13,750.00	15.00	16,500.00	30.00	33,000.00	20.00	22,000.00
6-4	Portland cement	Bbls.	1,700	2.70	4,590.00	3.20	5,440.00	4.00	6800.00	3.00	5,100.00	3.00	5,100.00	4.00	6800.00	3.50	5950.00
7-4	Liquid chlorine	Lbs.	2000	15¢	300.00	15¢	300.00	20¢	400.00	25¢	500.00	20¢	400.00	25¢	500.00	1.50	3000.00
8-4	Chlorine dosing machine		1	2,500	2,500.00	4,500	4,500.00	2,000	2,000.00	2,500	2,500.00	1,000	1,000.00	2,000	2,000.00	1,500	1,500.00
					90,085.00		102,390.00		107,590.00		120,050.00		121,650.00		161,500.00		252,100.00

				JAMES J. COUGHLAN & SONS, INC. 27 SCHOOL ST. BOSTON, MASS.		*DRAVO CONT. CO. DRAVO BLDG. PITTSBURG, PA.		WINSTON & CO. INC. 240 FAIR ST. KINGSTON, N.Y.		JAMES J. COUGHLAN & SONS, INC. 27 SCHOOL ST. BOSTON, MASS.		DRAVO CONT. CO. DRAVO BLDG. PITTSBURG, PA.		WINSTON & CO. INC. 240 FAIR ST. KINGSTON, N.Y.		M. F. GADDIS 6 BEACON ST. BOSTON. MASS.	
				ALTERNATE B		ALTERNATE B		ALTERNATE B		ALTERNATE C		ALTERNATE C		ALTERNATE C		ALTERNATE C	
ITEM	DESCRIPTION	UNIT	QUANTITY	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT
1-4	Earth excavation to surface of rock	Cu. Yds.	225	6.50	1462.50	10.00	2250.00	19.00	4,275.00	6.50	1,462.50	10.00	2250.00	19.00	4,275.00	20.00	4,500.00
2-4	Rock excavation in shaft and tunnel	Cu. Yds.	4,200	13.45	56,490.00	13.00	54,600.00	19.00	79,800.00	13.45	56,490.00	12.50	52,500.00	19.00	79,800.00	21.00	88,200.00
3-4	Shaft and tunnel drainage	Lin. Ft.	540	9.75	5,265.00	15.00	8100.00	10.00	5,400.00	9.75	5,265.00	15.00	8100.00	10.00	5,400.00	5.00	2,700.00
4-4	Forms for concrete lining	Lin. Ft.	430	15.75	6,772.50	20.00	8600.00	10.00	4,300.00	15.75	6,772.50	20.00	8600.00	10.00	4,300.00	3.00	1,290.00
5-4	Concrete lining	Cu. Yds.	1,100	11.55	12,705.00	15.00	16,500.00	12.50	13,750.00	11.55	12,705.00	15.00	16,500.00	12.50	13,750.00	10.50	11,550.00
6-4	Portland cement	Bbls.	1,700	2.70	4,590.00	3.20	5,440.00	3.00	5,100.00	2.70	4,590.00	3.20	5,440.00	3.00	5,100.00	4.00	6800.00
7-4	Liquid chlorine	Lbs.	2000	15¢	300.00	15¢	300.00	25¢	500.00	15¢	300.00	15¢	300.00	25¢	500.00	14¢	280.00
8-4	Chlorine dosing machine		1	2500	2,500.00	4,500	4,500.00	2,500	2,500.00	2,500	2,500.00	4,500	4,500.00	2,500	2,500.00	4,000	4,000.00
					90,085.00		100,290.00		115,625.00		90,085.00		98,190.00		115,625.00		119,320.00

†Advertised as Contract 8

*Contract awarded to Dravo Cont. Co. May 24, 1927.

CANVASS OF BIDS FOR CONTRACT 13 OPENED JULY 15, 1927.

COMMONWEALTH OF MASSACHUSETTS
METR. DISTR. WATER SUPPLY COMMISSION
CONTRACT 13

CONSTRUCTING 20" PIPE LINE FROM WHITEHALL RESERVOIR TO DAM ON CITY BROOK IN THE TOWN OF HOPKINTON.

ITEM	DESCRIPTION	UNIT	QUANTITY	* ① PORTLAND CONT. CO. INC 97 EXCHANGE ST. PORTLAND, ME.		② MARK E. KELLEY 35 FOSTER ST. PEABODY, MASS.		③ R. H. NEWELL CO. UXBRIDGE, MASS.		④ CENEDELLA & CO. 68 SCHOOL ST. MILFORD, MASS.		⑤ GENERAL CONT. CO. INC 32 BEACH AVE. SALEM, MASS.		⑥ JOHN H. MCCUSKER 62 CHURCH ST. WALTHAM, MASS.		⑦ J. J. DUCEY 1295 WORCESTER ST. FRAMINGHAM, MASS.		⑧ A. PHELPS & SONS 5150 BRADEN ST. DETROIT, MICH.	
				PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT
1.	Connection to gatehouse at Whitehall Reservoir	Lump	Sum	450.00	450.00	646.00	646.00	750.00	750.00	1000	1000.00	1000	1,000.00	850.00	850.00	300.00	300.00	1,200	1,200.00
2.	Furnishing 20" C.I. pipe and special castings	Lin. Ft.	6800	4.25	28,900.00	4.48	30,464.00	4.80	32,640.00	4.10	27,880.00	3.90	26,520.00	6.30	42,840.00	5.60	38,080.00	7.25	49,300.00
3.	Laying 20" C.I. pipe and special castings	Lin. Ft.	6800	0.92	6,256.00	0.75	5,100.00	0.70	4,760.00	1.40	9,520.00	1.00	6,800.00	0.25	1,700.00	1.00	6,800.00	0.80	5,440.00
4.	Excavation, fill and refill	Cu. Yds.	4000	2.40	9,600.00	2.65	10,600.00	2.80	11,200.00	2.75	11,000.00	4.00	16,000.00	2.50	10,000.00	3.00	12,000.00	1.50	6,000.00
5.	Excavation fill and refill	Cu. Yds.	1700	1.22	2,074.00	4.27	7,259.00	2.70	4,590.00	4.00	6,800.00	4.00	6,800.00	5.00	8,500.00	6.00	10,200.00	5.00	8,500.00
6.	Upper Mill Pond crossing	Lump	Sum	3,500	3,500.00	1865	1865.00	5000	5000.00	5,500	5,500.00	5000	5,000.00	3,590	3,590.00	3,600	3,600.00	5,700	5,700.00
7.	Furnishing and constructing one 4" blowoff	Lump	Sum	25.00	25.00	182.00	182.00	150.00	150.00	100.00	100.00	150.00	150.00	150.00	150.00	160.00	160.00	90.00	90.00
8.	Furnishing and constructing one 2" air relief. Type A	Lump	Sum	23.00	23.00	125.00	125.00	150.00	150.00	200.00	200.00	150.00	150.00	160.00	160.00	125.00	125.00	90.00	90.00
9.	Furnishing and constructing one 2" air relief. Type B	Lump	Sum	135.00	135.00	250.00	250.00	900.00	900.00	200.00	200.00	300.00	300.00	290.00	290.00	230.00	230.00	210.00	210.00
10.	Excavation at the diversion dam on City Brook	Cu. Yds.	100	1.50	150.00	2.50	250.00	5.00	500.00	4.00	400.00	4.00	400.00	5.00	500.00	4.00	400.00	2.00	200.00
11.	Furnishing and placing impervious core and blanket in diversion dam	Cu. Yds.	550	1.60	880.00	1.50	825.00	2.50	1375.00	3.00	1650.00	5.00	2750.00	3.00	1,650.00	3.00	1,650.00	2.00	1100.00
12.	Furnishing and placing pervious embankment in diversion dam	Cu. Yds.	1200	1.60	1920.00	1.40	1680.00	1.75	2100.00	1.75	2100.00	4.00	4800.00	2.00	2400.00	2.50	3000.00	1.25	1,500.00
13.	Furnishing and placing soil dressing	Cu. Yds.	100	2.00	200.00	2.25	225.00	2.00	200.00	3.00	300.00	5.00	500.00	2.00	200.00	3.00	300.00	1.25	125.00
14.	Furnishing and placing concrete	Cu. Yds.	30	19.00	570.00	20.00	600.00	30.00	900.00	20.00	600.00	25.00	750.00	30.00	900.00	20.00	600.00	24.00	720.00
15.	Furnishing and placing paving	Cu. Yds.	25	8.00	200.00	8.00	200.00	10.00	250.00	8.00	200.00	10.00	250.00	5.00	125.00	10.00	250.00	10.00	250.00
16.	Furnishing and placing 20" shear valve at pipe line outlet.	Lump	Sum	80.00	80.00	250.00	250.00	250.00	250.00	300.00	300.00	300.00	300.00	150.00	150.00	450.00	450.00	300.00	300.00
					54,963.00		60,521.00		65,715.00		67,750.00		72,470.00		74,005.00		78,145.00		80,725.00

* Contract awarded to Portland Contracting Co. Inc. July 15, 1927

CANVASS OF BIDS FOR CONTRACT 16 OPENED SEPT 23 1927.

COMMONWEALTH OF MASSACHUSETTS
METR. DISTR. WATER SUPPLY COMMISSION
CONTRACT 16

FOR CLEARING AND EXCAVATING OPEN CHANNEL FROM DIVERSION DAM ON CITY BROOK TO HOPKINTON RESERVOIR IN THE TOWN OF HOPKINTON.

				* ① SANDERS ENG. CO 102 EXCHANGE ST., PORTLAND, MAINE		② FRED W. CARLSON 36 SHAW R'D, BRIDGEWATER, MASS.		③ C. & R. CONST. CO., 75 BRADEIN ST., ROSLINDALE, MASS.		④ CENEDELLA & CO., 68 SCHOOL ST., MILFORD, MASS.		⑤ EDWARD O'TOOLE 237 WASHINGTON ST. WESTWOOD, MASS.		⑥ CHARLES E. HORNE MILLBURY, MASS.		⑦ A. G. TOMASELLO & SONS INC. 250 STUART ST., BOSTON, MASS.	
ITEM	DESCRIPTION	UNIT	QUANTITY	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT
1.	Clearing specified areas in diversion reservoir and along line of channel.	Acre	30	270.00	8,100.00	125.00	3,750.00	300.00	9,000.00	200.00	6,000.00	200.00	6,000.00	200.00	6,000.00	200.00	6,000.00
2.	Grubbing specified areas in diversion reservoir.	Acre	8	450.00	3,600.00	275.00	2,200.00	300.00	2,400.00	350.00	2,800.00	200.00	1,600.00	800.00	6,400.00	1000.00	8,000.00
3.	For channel excavation and grading.	Cu. yd.	20,000	1.10	22,000.00	1.50	30,000.00	1.50	30,000.00	1.65	33,000.00	1.95	39,000.00	1.90	38,000.00	2.40	48,000.00
4.	For gravel fill in channel and highways.	Cu. yd	500	4.00	2,000.00	3.00	1,500.00	2.50	1,250.00	4.00	2,000.00	2.50	1,250.00	2.00	1,000.00	4.00	2,000.00
5.	Furnishing and laying 30" cast iron culvert pipe.	Lin. ft.	24	15.00	360.00	15.00	360.00	25.00	600.00	15.00	360.00	12.00	288.00	15.00	360.00	20.00	480.00
6.	Furnishing and placing concrete.	Cu. yd.	30	22.00	660.00	30.00	900.00	18.00	540.00	30.00	900.00	30.00	900.00	20.00	600.00	15.00	450.00
					36,720.00		38,710.00		43,790.00		45,060.00		49,038.00		52,360.00		64,930.00

				⑧ PETER SALIUCCI 55 POND ST., WALTHAM, MASS.		⑨ MARK E. KELLEY CO. INC. 35 FOSTER ST. PEABODY, MASS.		⑩ ANTHONY ROSS & SON 627 MASS. AVE., LEXINGTON, MASS.		⑪ ANTONIO MOGAVERO 6 DANE ST., PEABODY, MASS.		⑫ M. I. O'CONNOR 696 BRIDGE R'D NORTHAMPTON MASS.		⑬ RAYMOND A. BERGESSON 41 BAXTER ST., WOONSOCKET, R. I		⑭ GEORGE T. RENDLE Co 270 CONDOR ST., EAST BOSTON, MASS. (Informal bid)	
ITEM	DESCRIPTION	UNIT	QUANTITY	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT	PRICE	AMOUNT
1.	Clearing specified areas in diversion reservoir and along line of channel.	Acre	30	500.00	15,000.00	832.00	24,960.00	300.00	9,000.00	600.00	18,000.00	825.00	24,750.00	200.00	6,000.00	800.00	24,000.00
2.	Grubbing specified areas in diversion reservoir.	Acre	8	1200.00	9,600.00	950.00	7,600.00	600.00	4,800.00	1000.00	8,000.00	2,500.00	20,000.00	500.00	4,000.00	600.00	4,800.00
3.	For channel excavation and grading.	Cu. yd.	20,000	2.00	40,000.00	2.00	40,000.00	3.00	60,000.00	2.45	49,000.00	1.90	38,000.00	6.00	120,000.00	3.80	76,000.00
4.	For gravel fill in channel and highways.	Cu. yd.	500	3.00	1,500.00	2.00	1,000.00	2.00	1,000.00	3.00	1,500.00	4.20	2,100.00	5.00	2,500.00	3.00	1,500.00
5.	Furnishing and laying 30" cast iron culvert pipe.	Lin. ft.	24	30.00	720.00	15.00	360.00	15.00	360.00	15.00	360.00	18.00	432.00	3.00	72.00	48.00	1,152.00
6.	Furnishing and placing concrete.	Cu. yd.	30	40.00	1,200.00	20.00	600.00	25.00	750.00	25.00	750.00	30.00	900.00	40.00	1,200.00	16.00	480.00
* Contract awarded to Sanders Eng. Co. Sept. 23, 1927.					68,020.00		74,520.00		75,910.00		77,610.00		86,182.00		133,772.00		107,932.00